This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

The Plant World

BY E. TWINING

The Sugar Cane

THE PLANT WORLD

Cedar of Lebanon

THE

PLANT WORLD.

By

ELIZABETH TWINING,

Author of "Illustrations of the Natural Orders of Plants"

LONDON:

T. NELSON AND SONS, PATERNOSTER ROW;

EDINBURGH; AND NEW YORK.

1866.

191. K. 22.

BIBLIOTHECA BODLEIANA

PREFACE.

THE study of Natural History is now become generally a part of education; there is no branch of it so suitable and interesting to the young as that which treats of Plants. They are of such continual use to us in various ways that it is impossible not to know something about them, and also not to desire to know more. They afford subjects of observation and thought well calculated to strengthen the faculties of a young mind; and the search for growing plants during a walk in the country gives great interest and delight. Thus even a slight study of plants tends to promote a healthy development of mind and body. Many subjects can only be learned

from books, and this is sometimes a tedious process to young children, as well as to older persons, who, from their position in life, are unaccustomed to quiet study. But plants offer visible and attractive objects, and are always within reach, under some form or other, to all scholars, whether in town or country.

The science of Botany was, until lately, so peculiarly enveloped in technical scientific language that young persons were almost entirely deterred from learning it. I have, therefore, endeavoured in a humble manner to clear a path for young students, and to show that plants may be admitted amongst the subjects of the highest and yet simplest interest to all classes of learners. Moreover, the study of these most beautiful as well as useful objects of creation does in a remarkable manner help to expand the ideas, and lead to a more perfect comprehension of important subjects of consideration.

All difficult technical and scientific words

have been avoided as much as possible; and the endeavour has been to render the subject sufficiently interesting to induce readers to search further for themselves. Although there have appeared many books on plants lately, yet they are not generally adapted to the comprehension of those young students who have no acquaintance with other languages. Natural history may now be said to form a part of the education of nearly all classes, and for many reasons plants will always be a favourite branch of the study. We hear of students at the Universities refreshing their minds, after the more abstruse studies of classics and mathematics, with observations on natural history. Young lads at public schools often amuse themselves during a walk with searching after specimens of the vegetable world. In the new middle-class schools for girls, the lessons on natural history are well attended; and in the lower schools for the poor, a simple lecture on plants, illustrated by specimens or drawings, has been found acceptable, and to

be able to fix the attention of those who are not accustomed to listen. The subject interests them, because it treats of things familiar to them, seen by the eye, yet not understood by the mind.

E. T.

13 Bedford Place, London.

CONTENTS.

Chapter		Page
I.	ON PLANTS IN GENERAL, ...	9
II.	ON SEEDS, ...	33
III.	THE ROOT, ...	56
IV.	THE STEM, ...	82
V.	THE LEAF, ...	115
VI.	THE FLOWER, ...	145
VII.	THE FRUIT, ...	183
VIII.	PALMS, ...	220
IX.	ON CORN, SUGAR, AND VINES, ...	260
X.	ON TEA, COFFEE, AND COCOA, ...	295
XI.	ON HEMP, FLAX, AND COTTON, ...	340
XII.	GENERAL REMARKS ON PLANTS, ...	376

THE PLANT WORLD.

CHAPTER I.

ON PLANTS IN GENERAL.

"In the beginning God created the heaven and the earth," as we read in the first verse of the first book of the Holy Scriptures. After relating the works of the two first days of creation, during which God the Almighty Creator made the light and the darkness, and divided the waters from the firmament, we are told that the work of the third day was to separate the waters from the land. The dry land thus became ready and fit to produce plants; and then "God said, Let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind, whose seed is in itself, upon the earth: and God saw that it was good." The covering of the

earth, that vegetation which God created on the third day of this world's existence in its present state and form, is a subject of the highest interest to man, the chief work of creation. The wise king Solomon despised not the knowledge of plants, but studied them, and knew them all, from the cedar of Lebanon to the hyssop on the wall.

The history of plants is the history of the most useful objects to man; they have afforded to the whole human race, from that time to the present, food, clothing, and countless objects necessary to the health and comfort, even to the very life of man.

Before entering on the vast subject of the variety of vegetation and its innumerable uses, let us observe what a striking illustration it offers of the might and wisdom of the Creator, ever ruling and ordering all things; and also possessing that wondrous, and, to our weak understanding, incomprehensible power of enduing his works with a continued life. From the day on which it was said, "Let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit," it has not failed in

its appointed law. Each plant has continued to bring forth fruit and seed after its kind, so that none have become lost or altered, but remain year after year witnesses of the everlasting power of their Creator. After man had been formed by the divine will, and all things given to him to have dominion over them, every herb and every fruit-tree was given to him for food, but not without care on his part. The first work appointed to Adam was the cultivation of plants: "And the Lord God planted a garden eastward in Eden; and there he put the man whom he had formed. And the Lord God took the man and put him into the garden to dress it and to keep it."

The due apportioning of plants in various parts of the world is one of the first necessary arts of man. On arriving at a new land in a wild, uncultivated country, as in the far west of North America, the first work usually is to cut away and clear forests, and then dig up and prepare the ground for crops of eatable, or otherwise useful plants. In other countries, where marsh land prevails, the first work is to drain the soil, eradicate mosses and other small plants, and so

prepare the ground for cultivation. The effect of vegetation on the air is most important; in the West Indies the forests, that in some islands originally covered the hills, kept the air cool, and averted many dangerous vapours. In other dry and cool regions the planting of trees has tended to the improvement of the climate, and consequent advantage to health. Not only do plants in themselves benefit the air, and cause a healthy state of atmosphere, but we are also indebted to them for the first formation of soil whereon other plants may afterwards grow. When the coral insects have raised their submarine structure above the surface of the ocean, their work ceases, and the vegetable race begins; small lichens and mosses grow on it, they flourish and decay, and so gradually but surely form a layer of soil, on which seeds, as they are floated past on the winds, are deposited and take root. In process of time the once barren islet becomes clothed with a covering of various small plants; and at last it is adorned with a grove of palm-trees, and stands as a landmark to the ships of the ocean, waving its graceful crest of palms in the breeze.

To learn the different properties of plants, and the ways in which they can be best applied to our use, is very necessary to many, and in some degree useful and pleasant to all men. As the different countries of the world vary in their climate, and soil, and nature, so also do the plants which grow in them. Everything is adapted to its right place; and more particularly is this observable in plants. Those which require a hot, moist air, cannot grow in a cold, dry country. Those which thrive in low marshes are not able to live on exposed mountains. Those which live in the shade of forests would be scorched and withered on the open plains. Corn grows best in the fields of temperate Europe; if it is cultivated in hot countries, it must be on mountains raised above the heated air of the plains. For instance, in South America wheat corn is unknown in the fields of the valleys or plains; in such low situations only Indian corn or maize grows: but wheat is cultivated on the lofty mountains of the Andes, at four thousand feet elevation above the sea. There, as on all mountains, the air becomes cooler, consequently is fitted for the growth of more hardy plants than that of

the plains. Corn requires a certain degree of coldness to enable it to acquire firmness of stalk and hardness of grain. Yet too great cold injures it; for it cannot grow or ripen in the more northern countries of the world. Rye is of a hardier nature than wheat, and can be cultivated in Iceland and the northernmost isles of Scotland, where it would be too cold and bleak for wheat. The poor Laplanders and Greenlanders have but a very small supply even of rye-corn to make into flour, and are often obliged to mix with it the pounded bark of the birch-trees which abound in the northern parts of Europe. With these two kinds of meal together they make their biscuits, more like oat cakes than anything we call bread.

Some plants require moisture, others a dry soil; some require a considerable degree of heat, others come to perfection in a cooler or drier atmosphere. Rice is one of those plants which must have both warmth and a good supply of water to enable it to produce a due quantity of the useful seed. It is therefore cultivated in fields that are intersected by small streamlets of water; in China and the East Indies very abun-

dantly, and in less hot countries it can grow if only sufficient moisture to the roots can be obtained. In the flat plains of Lombardy, in the north of Italy, rice thrives tolerably well. In England it is never to be seen in open fields; but it is occasionally grown, as a rare specimen of a foreign plant, in the water-tanks of conservatories, where the air and water are both kept at a warmer temperature than the outward air. In the Botanic Garden of the Regent's Park, London, it may be seen in summer, with its graceful drooping stalk bearing many seeds. The best rice is grown in Carolina, two of the south-eastern provinces of the United States of North America.

A large proportion of the plants which contribute most to the nourishment of mankind grow in the hotter regions of the world. Tea, coffee, chocolate, sugar, and all the spices, thrive in the hot countries or islands of the tropics. Potatoes, corn, the various kinds of cabbages, turnips, and such large succulent-rooted vegetables, grow best in Europe, and the temperate countries throughout the world. As we perceive that plants are by the wisdom of the Creator

especially adapted to their respective countries, so we must be assured that as the bountiful supply of a plant is limited naturally to its native country, it is intended that man by his power of travelling about to various countries, and of transporting their produce, should distribute it to his fellow-creatures. Thus, by exchanging the vegetable produce of different countries, the mutual advantage is great. The negroes in the West Indies cultivate immense plantations of sugar; they are contented themselves with a few pieces of the sweet cane filled with its pleasant nourishing juice. The chief supply is made into sugar, and brought in ships to all those cool countries where it is impossible for the sugar-cane to grow in the open air. In the West Indies, also, is found most abundantly the cotton plant, bearing its bright yellow flowers. After a few days these wither and fall off, leaving the seed-vessel to enlarge and ripen till the pods burst, and the dark brown seeds are seen in the midst of a mass of white, soft, downy cotton. Of what use could this plentiful gift of God's goodness be to the poor natives? They have no means of making anything useful of it. They

can neither spin it into thread, weave it into cloth, nor dye it of various pleasing colours. But European ships go to their seaports, and receive the great bales of cotton which the negroes have gathered and made up. It is brought to Liverpool, and thence conveyed to Manchester and other of our large manufacturing towns; the cotton is carefully cleaned, and prepared, spun, woven, bleached, dyed of various patterns, pressed, and finished. Some are made neat and suitable to English taste; but the manufacturer knows the desire of the poor black women for gay-coloured garments, and he has always a portion printed in bright, gaudy patterns. These are sent out to the West Indies; and, as soon as the goods are exposed in the market, the women come to buy a new piece for a dress, or a gay red and yellow handkerchief to wear over their heads. The neatly dressed Englishwoman could not have her pretty cotton gown, nor the lady her elegant muslin for summer, without the help of the negro women working in the hot cotton plantations of the West Indies. Nor could the freed slave, desirous of dressing herself after the fashion of her European mistress,

have the cotton pods she had helped to gather transformed into the gay dress she is so pleased to wear, without the aid of the English manufacturer.

Thus we see that plants, even the humble and lowly, assist in the one great and divine law that must ever be fulfilled in this world, that man is born to labour for his own benefit and happiness, and for that of his fellow-creatures. Each must work in the lot appointed him by the heavenly Master; and each does in thus working bring profit to himself and to his brethren. From the time when it was commanded to Adam to go forth and labour—"In the sweat of thy face shalt thou eat bread"—it has continued one of the unchanging laws of God. And especially in the labour of the field it is evident that, although the earth does bring forth abundantly, and there are few spots that can be called barren, yet man's skill and care are needed to make all ready for his use. A very large portion of the plants which spring up naturally, are what we call *weeds*, that is, either not the right kind of plant we desire in that place, or such as from their nature are useless, or possibly injurious to man.

Those plants which afford nourishment to man or cattle, for the most part require careful attention, to prepare the good ground for the seed, to keep it clear from weeds as it is growing, and lastly, to gather in the crop when it is ripe. God does truly give abundance; but all his blessings man must seek for, and bestow care on the means which produce them. When man soweth, then, and then only, "shall the earth bring forth her increase, and God, even our own God, shall give us his blessing."

On this vast subject of plants it is difficult to decide how and where to begin the study. So various are they, so profuse in the abundance with which they cover the surface of the earth, that we may easily suppose at first that it is one of those studies which the life of man cannot suffice for. But, like many other things, the difficulty is greater in idea than in reality; and as we proceed in the examination, and gain acquaintance with some of the principal plants valued for use, we gradually find the confused mass become clearer, and we perceive order and harmony to pervade this as well as all other parts of creation. Moreover, there is no branch

of natural history that so readily and pleasantly repays us the trouble of learning: in countless ways it adds great interest to our daily life, and is able to give delight to all classes, in whatever station their lot may be. There is no pleasure more natural to us than the taste for flowers, nor need we wonder at it: it exists in all countries of the world, more or less, and has done so from the beginning of time. Neither can we doubt that it is one of the most pure and innocent of enjoyments afforded by the various objects of creation. We have the sanction of the highest Wisdom for this study, and perceive that not only is it a source of delight of a passing kind, but that, if we "consider the lilies of the field" with an earnest mind, we shall derive thoughts of confidence and trust towards our great Creator, and thoughts of meekness and humility to our hearts. Of how much value has the careful observation of plants been to persons in different circumstances, and in endless ways; we might occupy the whole chapter with such anecdotes. We are, perhaps, too apt in this age of utility to value things according to their actual use to us; if we can make anything of

use for building, for clothing, or for food, it is sure to be sought for and esteemed. But there is another kind of value besides this, which should not be overlooked or despised; there is a cheering, pleasant influence on the mind and spirits to be derived from plants and the care of them. How many solitary persons have found the greatest solace in watching a few plants in their room, even when confined to that, and having no garden at all! We read of a prisoner in a strong castle in the north of Italy, a good and clever man, but strictly confined on account of supposed political offences against the government of his country. No amusement of any kind was permitted him; but he found it in a small plant that sprung up amidst the stones of the court where he was allowed to walk for a short time daily. Observing its growth cheered his mind, and raised his thoughts from his miserable condition.

When one of the first travellers in the interior of Africa was endeavouring to trace out the course of the river Niger, he was one day so weary and exhausted on his journey, that he lay down desponding on the ground. A small moss growing

beside him attracted his notice; he took it up and examined it, admired its slender, yet perfect form—the little stalk with its delicate, fine-pointed leaves—the tiny seed-vessel like a cup, with a lid on it to protect the seeds till ripe,—all so wisely and beautifully made, and exactly, without doubt, after the very same pattern as had been given to it on the third day of creation, when the "herb yielding seed" was first brought forth by the earth, and God, the maker of heaven and earth, "saw that it was good." Such considerations led to the assurance that, if God had so cared for a humble moss, he would surely care for him, a lonely wanderer in the desert. He felt comfort and encouragement in his mind; and, after a short rest, resumed his way and soon reached a village, where some kind-hearted natives gave him refreshing food. Thus it is ever; "all things work together for good to them that love God;" yes, if we only love him for his humblest work's sake, that spark of love will kindle a higher and a holier love in our hearts, that will ascend from this lowly earth to the lofty heaven, and make us feel that we are one with him, and he with us; that we are not alone

—not even the solitary wanderer in the wilderness.

Some things we cannot learn if we would; they are too difficult for us,—far above, out of our reach; some objects are scarce and rare, not to be had by humble learners, but there is no difficulty about plants. A child can understand something of them, and they are to be found easily; they grow, indeed, almost everywhere; there is hardly a spot on the earth's surface without some kind of plant belonging to it. Not only on almost every space of ground in its natural state, but even on rocks and stones do plants grow; the small lichens often cover the surface of a rock, lying so flat and close upon it that it is impossible to break them away, and the colour is sometimes so like that of a rock, that at a short distance it is scarcely visible. In other instances the whole aspect of rocks is changed by small lichens. The granite rocks which form the "Land's End," or boundary of our island along the south-west coast of Cornwall, appear of a pale kind of buff hue, quite unlike the usual grey colour of granite; this is caused by the quantity of lichen which grows in

tufts, nearly covering the rocks exposed to the mild, moist air of the Atlantic Ocean. The minutest kinds of plants are often discovered in unexpected places. When some English ships first went to explore the unknown shores of the Arctic Ocean, a few officers and sailors landed on a plain covered with snow; they soon perceived one portion that looked as if *red snow* had fallen. This was considered a very remarkable circumstance, and at the time no one could explain what these extremely small, red grains could be. Since then, it has been ascertained that they were little plants, of the very lowest rank certainly, but of a vegetable nature. The blue mould which appears on old cheese is, in truth, a plant. The substance which comes on beer whilst it is fermenting and is called *yeast*, is also a plant. Thus we find that not only are we indebted to *plants* for the chief supply of food, clothing, materials for dwellings, but many curious substances are contained in the vegetable kingdom worthy of notice. And these minute plants, some of them almost invisible to the naked eye, afford to us as wonderful proofs of the skill of their

Maker, as can be seen in the trees of the forest. How vast is the difference which exists between the lowly moss rising scarcely an inch above the ground, with its simple stalk and tiny leaves, and the giant tree of an ancient forest, with its strong stem and tough branches; yet each tells us the same tale, and leads our minds to the same Source of life and growth.

Still more wonderful is the variety of size in the vegetable world, than in the animal races. There is the rock-lichen clinging on fast, yet a mere thin crust on the surface, with minute powdery seeds. From this humble specimen we can trace innumerable examples of every degree of size and development of growth and structure, till we come to the lofty palm rising to the height of an hundred feet, or higher.

Those who have wandered in the thick jungles of the East Indies have seen the most wide-spreading tree of the world, the great banian. From one stem spring forth many branches, from these droop downwards rootlets which, at last, penetrate the earth, and in their turn grow and send up fresh stems and branches, till one tree becomes a thousand, and a whole

army might find shelter under its shadow. The Hindoos consider it a sacred tree, a kind of emblem of the beneficent protection of the Deity. They place idols under its shade, and love to wander and meditate beneath the thick branches, which form a very welcome refuge in the scorching climate of India. The Hindoos have a peculiar feeling for plants, and not only make their chief food of them, but use flowers for adorning their temples. Some are especially devoted to this purpose; the red-flowered Ixora, which is now often to be seen in our conservatories, is a native of Malabar, and was named after one of the idols of that country, at whose shrine it is offered.

The tallest tree now known has been lately discovered in California, it is named Wellingtonia, and has a stem three hundred feet high, that is, nearly as high as St. Paul's Cathedral in London. The branches grow chiefly towards the upper part; the trunk is about twenty feet across, and is surrounded by a very remarkable bark, of which a specimen is now to be seen in the Crystal Palace at Sydenham. This tree is of the fir tribe, and bears its seeds in a cone

like our Scotch pine. Thus we find an immense variety in the scale of size amongst plants, and our knowledge in this respect is much enlarged since the days of Solomon, for he knew not the giant Californian pine, so far surpassing in height the loftiest cedar of Lebanon.

If we turn our thoughts to the structure and formation of plants, there also is a subject for the highest admiration; what a vast range of variety and design do we perceive, and throughout the whole the most perfect wisdom ordering each and every part, and fitting it to its allotted place in the creation! From the humblest examples on the lowest step of vegetable life,—the little grains like red snow on the plains of the Arctic regions, or the slender mould which springs out of decaying substances,—let us follow the course upwards to the perfect flower of a large tree, such as the horse-chestnut, fully developed in all its parts, embellished with delicate colour, curious in its plan, perfectly adapted to its intended purpose, and, moreover, beautiful and refreshing to the sight of man. And not merely cheering to our bodily eyes are all these

things of the vegetable kingdom; do they not all help to raise up our hearts and minds to Him who made them for us, "which doeth great things and unsearchable; marvellous things without number?"

Amongst plants we remark exceedingly various examples of duration of existence. There is the delicate mushroom, that bursts out of the ground during the twilight and dew of a summer night, attains its full growth, ripens its innumerable minute seeds, scatters them around, and, ere the sun has set a second day upon it, has already withered and decayed, crumbling into the dust from whence it came forth. Other plants require several months to fulfil their prescribed course of life. The farmer sows corn-seed in the autumn, it abides a few weeks in the dark earth, then sprouts the green blade, awaiting the due time, and gradually, through the showers of spring and the summer sun, it unfolds the precious grain, and it becomes hard and ripe, fit for the food of man. Then, when a man plants vines in his vineyard, he must wait patiently for the hot sun of two seasons before there will be any grapes on the young

vines wherewith to make wine. The acorn that is sown by a little child in his father's field, will not be grown into an oak ready for the ship-builder, until his children's children in the second or third generation shall have become inheritors of the estate, for an hundred years are wanting to enable the stem to acquire sufficient size and hardness of wood for the purposes of man in carrying him over the wide ocean.

If we listen to a celebrated French traveller on the west coast of Africa, we shall hear of the ancient Adansonia or baobab, which he found growing there, with its enormous trunk and huge mass of branches and foliage. From examination, he supposed it to have existed for the space of five thousand years, and to be still in full vigour, without any sign of coming decay.

There are several very ancient trees existing in Europe, of which the age is known with tolerable accuracy; for some were planted on special occasions, and the event recorded as a historical fact. A lime-tree in Germany is supposed to be upwards of one thousand years

old. There is an oak in France, which was planted in 1070, by one of the first Counts of Champagne. It is thirty feet high before the branches begin, and though the stem is hollow, it continues to flourish and bear acorns. A lime-tree, in the south of France, has reached the height of one hundred feet, and measures thirty five feet around the stem; it is said to be more than eight hundred years old. Some yews, planted in church-yards, have their dates well certified, and are known to be above two thousand years in age. Indeed, it may be concluded, that we cannot count time in vegetable life after our usual manner of reckoning; for, in some instances, it appears as if no wearing came with passing years, and in others, as if the space of a few days, or even hours, was destined to accomplish a complete work and bring it to a close. It has been supposed by an eminent French naturalist, that vegetable life in trees is never extinguished by time, but by accident or disease that causes decay.

All these manifold works of God teach us a lesson on the text, "Beloved, be not ignorant of this one thing, that one day is with the Lord

as a thousand years, and a thousand years as one day."

There is another remarkable manner in which we perceive the wonderful vitality that exists in vegetable nature, even when not actually growing in the earth. Many years ago the celebrated English poet, Pope, received a present of figs from Turkey. The basket in which they were sent was made of the supple branches of the weeping willow of the East, that same kind under which the captive Jews sat and wept by the waters of Babylon, when they remembered Jerusalem and their happy land. The poet was a man of observation; and, remarking that one of the branches had small green leaf-buds on it, he planted it in his garden, on the banks of the Thames at Twickenham. It grew and flourished; the slender branches in due time drooped over the water, exactly as those of the parent tree had done in the East. From that one small twig all the weeping willows now in England have descended. An elector of Saxony was an excellent turner in wood. He sent to Spain for some pieces of orange tree to work with; but he died before

the wood arrived, and it was left neglected in an outhouse for some time. At last a gardener discovered with surprise that they had sent forth shoots, small branches, and leaves; he planted them carefully, and they became magnificent orange-trees, which still exist, and are amongst the finest in Europe.

In cutting through hills for the formation of railroads lately, many plants have sprung into existence from seeds which must have been hidden in the depths of the earth for unknown ages. Is not this yet another convincing proof of an Eternal Power that giveth life to all things?

CHAPTER II.

ON SEEDS.

In speaking of the natural history of a plant, that is, in describing a plant in its entire state of existence, its manner of growth, its structure and formation, it is difficult to decide which portion shall be considered first. For plants, we know, were in the beginning created complete, and then each at the close of its appointed duration produced seed, and withered, if an *herb*, or remained for future years of growth and reproduction, if a *tree*. But in the present time, it seems better to begin with the *seed* of a plant, that small portion from which the future plant proceeds. Although often very minute, and in outward form having no sort of resemblance to a full grown living plant, yet the seed does, in reality, contain all that is necessary to the development of one. This is a simple fact, and probably one of those common things of daily life supposed to be known to all. The most ignorant person has, no doubt, some idea

that a seed produces a plant, though he may be quite unable to explain anything about it. Thus it is that many are content to know in part, and make no effort to understand the whole. But is this the wise way indicated by the wisdom of our heavenly Teacher? Does the book which is meant to be the guide of all our ways give us no advice on this subject? Surely it does. Solomon was inspired with words which were written for our learning as long as the human race will last. "Happy is the man that findeth wisdom, and the man that getteth understanding; all the things thou canst desire are not to be compared unto her. Happy is every one that retaineth her." In this subject, of the seed of a plant, there is much to be learned and understood, much that well repays the time spent in gaining that portion of knowledge. We find a seed selected in the Bible as a fit illustration of one of the deepest subjects, as an emblem of the highest good. "A sower went out to sow his seed," and this seed was the word of God. The whole meaning shadowed out in this parable is most beautiful and full of instruction. If we examine what a seed is, and

how its office in the wide range of vegetable nature is accomplished, we shall perceive more clearly not only what it is in itself, but how well adapted it was to interpret the teaching of the Saviour, of him who "spake as never man spake." A seed is of various size and shape; that of some plants is extremely small, and contained in a soft outer covering; that of others is large, and enclosed in a hard, solid case. Other kinds are enveloped in a soft, eatable pulp, as in many so-called fruits. One of the smallest of seeds is that of mignonette; they lie along the sides of a small pouch open at the top. Another small seed is that of the poppy —thirty thousand in one head. One of the largest is that of the cocoa nut palm-tree. This seed has a hard, solid, woody shell, requiring a sharp saw to cut it open; and is enclosed, besides this, in a thick covering composed of exceedingly strong tough fibres.

The various kinds of *stone fruit*, as they are called, are merely those *seeds* which have a hard shell to the kernel, and a soft, fleshy, juicy covering. Peaches, nectarines, apricots, and cherries, are of this class. All these are

especially adapted for pleasant food to mankind—the agreeable sweet pulp being of no advantage to the seed itself.

It is very interesting to make experiments with sowing seeds, to watch the early sprouting of a seed and the first growth of vegetable life. After having lain the due time in the ground, where it obtains the three requisites for germination,—darkness, warmth, and moisture,—then the life of the seed begins. The first action that takes place is absorption of water by the skin of the seed, this causes the swelling of the seed; the two parts of which it is composed burst open, and the embryo, or future plant in a bud state, begins to develop itself.

One of the most simple of seeds to examine is the common almond. When deprived of its outside pulp, and its thin brittle shell, it remains covered only with its inner brown skin. If soaked in water this soon easily separates from the white seed, which then splits in half, and the tiny bud of the future almond-tree is seen at the end, safely embedded in its ample provision of white albumen to furnish moisture to the young plant in its early growth. This is

the portion of a seed which is wholesome and pleasant to eat; sometimes of a farinaceous, mealy nature, sometimes oily.

When the hard shell of the cocoa nut is sawn asunder, the interior is seen to be lined with a pure white substance; this is good to eat, but the use in regard of the seed itself is to supply it with nourishment during its development,—for in the midst of it lies the bud. Whilst the first growth is going on, this white albuminous portion, as well as the liquid which once filled the hollow space in the centre, becomes absorbed in the plant. There is an extraordinary proportion of nourishment in the seed of all palms, and the seed may be seen lying on the ground, still attached to the young plant, for several months after it is already some feet high. This process of the seed must take place in every instance in some degree, though, as in all things, there are exceptions. The three indispensable requisites are darkness, warmth, and moisture; but some seeds can dispense with darkness, as the mustard seed; this is often laid on flannel in water, and thus will germinate even if exposed to light. Still, the

absorption of water must be effected, and the acquisition of oxygen, which enables the seed to swell and burst, and the little leaf-bud to enlarge and develop itself. All this must be accomplished, whether the seed be designed to produce a tender herb, rising only a few inches above the surface of the earth, or to become a strong oak, with stem and branches that can withstand centuries of storm or sunshine with all the changes of season; or whether it be in its allotted place in the vegetable world, a lofty palm, with a straight column or stem, bearing on its summit a crown of graceful leaves, having in the centre a cluster of flowers yielding fruit, affording hundredfold more of nutriment to man from the *single seed* sown in the earth.

Here let us pause and consider by what means and by what force did the young tender plant of the cocoa nut make its way out of the hard strong shell, and through the outer strong fibrous case. If we wish to obtain access to the white portion of the cocoa nut to eat it, or the liquid in the interior to drink it, we find it necessary to use a saw to cut through the shell.

How, then, did the weak germ of the young plant break through and rise up through the earth? By certain changes, which are called chemical, because they are effected by the chemical elements of nature, oxygen and carbon. The seed has attained that state when vitality is given to it; it has lost some of the carbon, which kept it in a hard, dry condition; it has been enabled to obsorb oxygen; it has softened its nature; it is endowed with the vigour of life, and thus it is enabled to burst the bonds of its shell. Here, again, we may remark the peculiar aptness of the similitude of the *seed* to "the word of God." It is sown in the earth, it is hidden from sight, no one knows what process is going on, or how to assist it; but all know that seed must be sown,—sown in faith, and trust, and hope. Man cannot help it to burst its shell, but the dew of heaven can and does. The slender shoot pierces the earth and comes forth into the air. In the appointed time of harvest there is a full crop; for since the third day of creation the herb yields seed after its kind, and the tree yields fruit after its kind,—seed time and harvest fail not. Thus

it is with the word of God. It is sown in the heart of a child, early in life; there it lies hidden from sight, possibly dormant for a longer period than is expected, not yet warmed and expanded into vitality, no young bud of hope come forth, no stem of faith strong against the storms of life, no flowers of love, no fruit of good works—all seems cold, and hard, and dry; in some cases there is a doubt whether "the good seed," has been *duly* sown by the teacher or parent. But there it is, and sound in itself, only awaiting the dew of God's grace, the warmth of heavenly beams to expand it, and enable it to burst its dark abode and come forth and shine before men, in the brightness of truth and love. Possibly, also, the darkness of affliction may for a period be favourable to it; like the seed, if always exposed to sunlight, it grows hard, does not acquire any power of development, and shows no sign of life. The duration of the vital power in seeds is often very great; a considerable space of time may elapse, affording no favourable opportunity for growth, yet, when the propitious time arrives, the seed shows that the vitality still exists,

though it may have been in a dormant state for years. Some wheat found in a mummy case, supposed to have been there upwards of two thousand years, was sown in earth after it was brought to England; it grew and bore an abundant crop of that branching kind of wheat, to this day most commonly cultivated in Egypt. Another remarkable quality of some seeds, is that of being able to grow after having been exposed to boiling heat. Some raspberry seeds taken out of jam, which of course has been boiled in the preserving, grew when sown in earth. All seeds have not this power; those which contain albumen would be destroyed by boiling, and could not sprout afterwards. I have said that when a seed begins to swell it splits into two parts before the shoot comes forth. This is the case with all that large class of plants to which all our trees and many of our herbs belong. But grasses, corn, rushes, and the great palm tribe, grow in a different manner, which we will consider more fully hereafter. Only you must observe now, that a seed of any of these last mentioned plants does not open into two parts, but the young shoot comes

forth at the side or end, without breaking the shell in half. If you put the seed of an African date into earth and cover it with a glass, you may watch its growth very conveniently. A grain of corn will also afford an example of the manner of growth of the whole grass tribe. All these have one seed-leaf, that is, a thick fleshy leaf to nourish the young plant at first. Oaks and all our native trees have had these seed-leaves.

That the seed is the most important part of a plant, in regard to the continuance of the species, is very evident; for though some increase by offshoots, yet the seeds are the principal cause. Another valuable property is that of affording food to man. *Seeds* do in a large amount contribute to our nourishment. A great portion of the human race live chiefly on bread made of wheat or rye, the seeds of corn; the inhabitants of the northern countries of Europe are content with oat-cake, a thin kind of biscuit made of oatmeal, the bruised seeds of oats. The native races of India make their simple meal almost exclusively of the seed of the rice plant—of the grass tribe. Of this we will speak more

presently. In North America, where wheat does not thrive in all districts, the seeds of maize or Indian corn furnish the daily meals, prepared in various ways. The seeds of buck-wheat, here only used for feeding pheasants, are employed in America as food for man, very nice cakes of different kinds being made of them. Peas, beans of several kinds, and lentils, often mentioned in the Scriptures of the Old Testament, afford a large supply of wholesome nourishment in many countries both to men and cattle; sometimes being used whilst tender and green, and sometimes when they are become ripe and hard. Millet is the seed of a grass, very commonly eaten in soup in Germany and other countries of Europe.

All these seeds are valued for their simple mealy nature, very nourishing, but having no particular flavour or exciting qualities. Other seeds are esteemed for their aromatic properties. Of these, one of the most commonly known is mustard, so pungent in its taste that it is of use not only as a pleasant addition to many kinds of food, but is valuable also for medicinal purposes, in illness caused by inflammation. The

mustard plant is an herb growing naturally in England, having small yellow flowers, succeeded by long pods full of round seeds. The seeds of carraway, anise, dill, and coriander, are all aromatic, and of much value to man. They all belong to the same tribe of plants, of which we will consider more hereafter.

Another very useful article in daily cooking of food is derived from the seeds of a plant. The pepper of common use is the seed of the pepper plant of the East Indies and South America. The round seed is covered with a skin of a dark colour when ripe; if the seed be ground with the skin on, it is *black* pepper; if the skin be taken off before grinding, it is called *white* pepper. But the seeds most esteemed for their refreshing as well as nourishing properties are those of the coffee shrub. Those plants which possess powerful qualities, either aromatic or otherwise, are usually natives of the hot countries of the world. Accordingly, we find the coffee shrub growing in the tropics very abundantly, especially in parts of the East Indies and the West Indies. It also thrives remarkably well in Arabia. The fruit contains

two seeds, covered with a kind of tough shell-like parchment. The seed itself is of a horny substance and pale colour; the peculiar aromatic and refreshing properties are not developed until the seeds have been roasted over a fire. But of this very valuable use of seeds for food we must speak more in another chapter on the coffee plant, for it is one of great importance to man.

The seeds which may be considered next in value are those of the chocolate-tree. These form the chief nourishment of the natives of several countries of North and South America; and an immense quantity are sent to Spain, as well as to other countries of Europe. The fruit is large, and contains sometimes as many as thirty seeds. These are ground and made into different kinds of beverages, known as cocoa, chocolate, and broma, all very nourishing and wholesome. A further description of these very valuable seeds of the tropics shall be given in a future chapter.

The well-known spice called nutmeg is the seed of a tree which belongs to the hot regions of the world, more especially to the islands of

the Indian Ocean. The fruit is about the size of a small peach; it is fleshy outside, and contains one seed. After the flower has withered and fallen off, the fruit requires nine or ten months to grow to its full size and to ripen. The two valuable portions of the fruit are the netted covering of the seed called *mace*, and the kernel within the shell. When the fruit is ripe it splits open; the mace is then carefully taken out, the nuts are left to dry and harden in the sun; when the inner kernel is somewhat shrunk by the heat, the outer shell is easily cracked and separated from it. Although this is one only of the many uses of the seeds of plants, and may be thought of no great importance to man, yet it is not to be lightly overlooked. For many reasons nutmegs are valuable; as a spice for food they are in frequent use, and serve also to render some medicines more pleasant to the taste. But the chief interest of this one seed, which we call nutmeg, is that the trees grow abundantly in the tropical countries of the East, and have been found in considerable plenty in the north-west of Borneo, that vast country lately added

to British possessions. The soil and climate appear to be remarkably favourable for the cultivation of these trees; and, when the natives are encouraged and directed in the care and increase of the nutmeg plantations, there is no doubt that the whole progress of civilization will be more readily carried forward. Regular work, and traffic with European ships, is one of the best chances of improvement to the wild people of the uncivilized regions of the world. The trees produce large crops of fruit, as many as thirteen hundred being gathered from one tree in a season: when the quantity obtained by careful cultivation becomes greater, the benefits of this seed will be more widely diffused; and the price being cheaper, it will be more used by all classes. When the Dutch first took possession of some of the Spice Islands in the Indian Ocean, towards the end of the last century, they endeavoured to limit the growth of nutmeg-trees to their own islands of Banda and Moluccas; but such exclusive systems are no longer practised, and the growth and use of this agreeable spice increases continually. Upwards of sixty thousand pounds of nut-

megs are now consumed in this country annually.

This example of the value of a seed teaches us a wise lesson; as, indeed, do all the works of creation when duly considered. When we observe how such an apparently small object is full of value to us, and how, in the wisdom of the everlasting Word, it continues from the beginning of time on earth until now to bring forth fruit for the service of man, surely it adds its humble testimony to the truth of the Scripture. And, moreover, the history of the nutmeg tells us how the good things of this world may be abused; although God intends them to be means of comfort and help to us, how the evil, covetous heart of man has sometimes turned them into causes of misery. If we could look back half a century, we should see the nutmegs of the islands of the Indian Ocean cultivated by African slaves, the poor natives pining in want, and at last disappearing entirely from their once happy homes. Europeans were misusing this bounteous gift of the Creator, not using it wisely as a means of occupation and civilization of the dark Indian people, and at the same time obtaining a plea-

sant and a cheering luxury for the white nations of the West. Let us hope our new country of Labuan, off the vast continent of Borneo, will afford evidence to the Christian world that, in this middle of the nineteenth century, English settlers have discovered how to use the good things of this world without abusing them, and how all, even the lowly things of creation, can be made to work together for good to them that love God, and wish to teach their unenlightened fellow-creatures to love him also.

We have already noticed that, in studying plants, we find many testimonies to the truth of the Holy Scriptures; and this gives an interest of the highest kind to the study. We can, moreover, perceive more clearly the full meaning of many circumstances mentioned in the Bible, when we have learnt something of the nature and uses of plants. It is written, in describing the life and habits of St. John the Baptist, when he was preparing the way for One mightier than himself, that he dwelt in the wilderness, and "did eat locusts and wild honey." What is called locusts is now considered to be the seeds

of a plant that grows in Judea, and in warm countries of Europe. The plant is a herb bearing long pods full of seeds, much like beans. In Spain it is commonly known as "St. John's bread." The seed-vessels are mealy and wholesome, like almost all of the same tribe; but in the present days they are not thought good enough for the food of men, though they are generally used as a nourishing fodder for horses and cattle. Now, this perfectly coincides with the idea we have, and were clearly intended to form, of the manner of life which St. John led in the wilderness. His mission was to call men to repentance, to confess and forsake their sins, to be baptized with water. And what is one chief duty enjoined at baptism? To renounce vain, useless luxuries, used in excess. Thus did the holy Baptist practise what he taught. He ate of the simple productions of the wilderness, the seeds of this humble plant growing there wild, where it had sprung up naturally for centuries, year after year, withering away in autumn, and then fresh plants springing up from ripe seeds that had fallen out of the opened pod. Here is an instance of God's providing food for his chosen,

even in the wilderness, as he did of old for the wandering Israelites.

Having now spoken of the principal seeds which afford nourishing food to mankind, as well as of some which contribute pleasant flavour to the palate, we will mention a few of those seeds which are valuable on account of the oil they yield.

The general idea of seeds is, probably, that they are small, hard, dry objects, usually smooth and flat, and showing no trace of oil on the surface. However, several do contain a considerable portion of oil, which is obtained by pressure or by boiling. The seeds of flax are of a mealy nature, full of oil, which is expressed and used for various purposes in the arts and in medicine. The remaining farinaceous substance forms a very nourishing food for cattle. The softening properties of linseed, as it is commonly called, render it very useful as an infusion for coughs, and as a poultice for inflammation. The seeds of the West Indian Castor-oil plant yield a valuable oil for medicinal purposes; although belonging to the tropics, yet it grows and bears seeds in our gardens, but not in sufficient abundance

for use. The kernel or seed of the walnut has half its weight composed of oil of a sweet, pleasant nature. The variety of properties contained in seeds is very great; some are simply wholesome and nourishing, as those of a tall grass which grows by the side of rivers in our country, as well as in Holland and Germany; these are now collected and sold as an ingredient for puddings by the name of *Manna Kroup*. The seeds of doura, an African tree, are roasted like coffee, and when bruised and steeped in water and allowed to ferment, afford a pleasant drink to the natives of the interior of Africa. From the powdered seeds they also prepare cakes, which were a welcome food to Mungo Park during his dangerous journey. Other seeds are strongly aromatic and used medicinally. Cardamoms are of this class, and belong to a plant of the East Indies. One of the most powerful medicines and poisons is derived from the seeds of strychnine; and many others exist in this part of plants, which would require too much space to consider.

The seeds of some plants are of such regular size, that they have been in early ages adopted

as weights for the most precious things. The word *carat*, used for the weighing of gold and jewels is derived fron the seeds of an African tree. And at the present time, the goldworkers of Hindostan use the seeds of a lofty timber-tree to weigh their gold, one seed being equal to four grains. Other seeds are of use from their soapy nature, and are used by the natives of the countries where the trees grow, in washing their garments. We may now perceive how much we are indebted to *seeds*, and can find out many more proofs of this if we search diligently.

This subject may appear small, but, remember, the seed is the precious portion of the plant, that which all the rest is intended to work for. And why is it thus precious? Because it is that which is destined to spring forth into life, become a new plant, and bear abundant fruit full of good seed. All who cultivate the ground know the value of seed. If we have a garden, we should not neglect to sow a proper quantity of seed in the right time, being sure that, if we did not do so, there would be no new plants in summer,—no flowers,—no fruit. The farmer does not fail to sow the seed in his fields in due season, know-

ing he could not otherwise reap a plentiful harvest. So it is with us all, if we do not sow the seeds of wisdom in youth, we cannot expect to have the help of her fruits in the vigour of life, nor to reap any stores for old age. And if we do not put in the seed whilst the heart and mind are tender, and the memory clear, there will be very little fruit afterwards. The wise farmer sows when the earth is soft and moist, neither scorched and burnt up by the heat of summer, nor hardened by the frost of winter. Remember, also, that if we hope for a productive garden, we must not only sow good seed, but watch its future growth. We must diligently clear away all weeds that would choke the tender plants. They should be set free from all encumbrance, for the sun to shine on them, and the rain and dew to refresh them. All this is daily work to be attended to, and cannot safely be neglected, if we desire to have a productive or a beautiful garden. Let us follow the same course with the cultivation of our understanding.

Do not forget the seed sown; think of it; take care lest it become choked by the cares and occupations of daily life. Keep your minds

clear and free from *weeds*,—all those trifling, vain thoughts and things which too often occupy the attention of young persons. Do not imagine I desire you to neglect any duty of domestic life; I would not wish any one to do so, and, certainly, no young person; but I am persuaded that the words of Solomon are as true in this day as they were when he wrote them, that "wisdom is the principal thing; therefore get wisdom."

I would remind you, also, that One wiser than Solomon has warned us, that seed may fall on a stony heart and produce no fruit, or it may be choked by an overgrowth of weeds, and so also bring no fruit to perfection. But that if it fall on an honest and good heart, it may and will bring forth even an hundredfold.

CHAPTER III.

THE ROOT.

HAVING in the preceding chapter described the seed and its history, it is now time to consider the root, the first necessary part of a plant. It is the root which must be prepared to supply nourishment to the tender shoot; therefore, here, as in all the works of the Creator, we perceive a perfect forethought and due ordering of all things. At the earliest beginning of growth in a seed, the part intended to form the root begins to enlarge and lengthen, piercing the covering of the seed and penetrating the earth downwards. The shoot which is to form the future stem begins to grow upwards, seeking the light and air, whilst the root descends into the dark, moist earth, to find there a supply of food for the young plant.

But let us examine in what manner the root is enabled to collect nourishment for the young plant. The point of the root is extremely delicate in substance, formed of small cells of a soft,

spongy nature. As it grows chiefly at the point, these cells are always tender, and able to absorb moisture. The whole length of a root is composed, in the interior, of a woody substance united with the stem, and covered entirely with a softer substance like that of the extreme point, but less sponge-like. Although the end of a root is very tender, yet it has an extraordinary power of penetrating the solid earth, and insinuating itself between crevices of bricks, stones, or anything that may be in the way. As soon as the root has gained an entrance in the earth, it begins to branch out into fibres, each furnished with a sponge-like point ready to fulfil its allotted part towards the supply of food to the plant above ground. Roots are of various kinds in shape and size; those of some plants are much smaller than the plant above ground, whilst those of others are considerably larger. In some cases the roots and the branches remain in nearly equal proportion. There are two reasons why this difference exists, partly because there are two different duties the root has to perform. We have, hitherto, only spoken of one office, that of seeking moisture to supply the young

plant. The other office of the root is to enable the plant, whether it be a small herb, or a large tree, to hold firm in the ground,—to resist the effects of wind or other injurious influence upon it. Thus we find the roots of elms and other large trees extend to a very great distance underground, spreading on all sides like the branches of the stem above. In the cucumber and other succulent plants, the roots are exceedingly small in proportion to the size of the upper part of the plant. And this for two reasons: these kinds of plants do not lose their moisture so quickly by the pores of their leaves as many others do; and, being of that lowly kind which trail along the ground, they do not require the aid of a wide-spread root to support them firmly. The small Lucerne herb has a root composed of many branching fibres, much larger than the whole upper part, containing stem, leaves, and flowers. The shape of a root is extremely various; but in every instance it is furnished with its necessary parts to enable it to fulfil its intended functions towards the support of the plant. The root is a most important part of a plant, of whatever kind it may be; in

some instances, it appears to be able to furnish an almost sufficient supply of moisture, without the addition of rain or dew from above. Those who attend to a garden, or who keep small plants in a room, can observe how some are able to maintain freshness and vigour for a much longer time than others. Some, which have thin, slender leaves, will require water daily; others, with thick fleshy leaves, will only want a small supply after many days, the root being able to draw sufficient moisture from the earth when the leaves lose it slowly. Where the roots have space of ground to stretch out far, they penetrate to a distance in search of water; but however they may increase in length, still it is only by the point that they can draw up a fluid, and so transmit it along the cells of the whole root.

Here we have an instance of a general fact being commonly known, yet no clear reason for it understood. Many persons have an idea that it is best to water a plant at a short distance, not to pour the water immediately at the base of the stem, though they may not know the exact reason why it is better to do so. When the

fact is known, it explains to us also how large trees, which we must suppose require a considerable supply of water, continue to flourish when the ground directly around the stem is mere dry dust, being sheltered by the thick leaves and branches from the rain. The roots spread beyond the immediate shelter, and draw nourishment from the earth where it receives the dew and rain from the clouds. Thus, as the roots are continually spreading further, they reach to new soil, and acquire fresh nutriment when the old earth is exhausted. What an important use is the root, therefore, to a tree in this work of collecting nourishment for it. The other work, of which we have already spoken, is of similar importance—that of supporting it firmly in the ground. When an oak, an ash, or an elm, or any other large tree, has attained a full growth and great weight of branches, unless the roots beneath the surface had wide and firm hold far and deep, the tree could have no secure foundation, and would be exposed to certain injury from every wind that blew. Like a ship without an anchor in a storm, it would be liable to destruction. We can perhaps hardly imagine

what this risk is, in our calm, temperate climate; but in the tropical regions of the world the force of the wind in a hurricane is immense, bearing down the strongest trees before it. Even here there is sometimes an example, which shows us the wonderful power of wind against large trees which stand in its course. I saw once, in Somersetshire, a very remarkable instance of this. A violent storm of wind swept along a vale of grass meadows, in which were several very noble trees in the full foliage of summer, bearing a heavy weight of leaves full of sap. The hurricane passed with such extreme force, that it overthrew many of these fine trees, snapping them off within a short distance beneath the surface of the earth, leaving the long roots untouched—just in the same manner as the strong cables of anchors are snapped asunder. It was a curious sight, and a melancholy one too, to see so many magnificent timber-trees, that seemed destined to exist many years in vigorous beauty before yielding their valuable supply of timber to the shipbuilder or the carpenter, thus laid low on the ground before the time. But it was a strik-

ing proof of the power of wind, and of the use of roots, which, except on such a rare occasion as this was, are sufficient to keep the tree in an upright position against wind and storm.

Thus we perceive that for two reasons the roots are a most essential part of a plant; therefore, if it be necessary to remove a plant, of whatever size it may be, great care must be taken not to injure their points—the soft spongy portions by which they absorb moisture. Roots have a strong power of growth, both in length and size; they are almost exclusively formed in darkness and moderate moisture, and they are closely connected with the growth of the first leaves of a plant. Of their capacity for growing, a clear proof may be seen in many common plants kept in small pots. After a year or more without change, the roots will often be found to have filled up the whole pot in an entangled mass; and, being thus imprisoned and prevented from further growth in search of increased supply of nourishment, the whole plant begins to languish and decline in vigour. In another sense, also, the roots may be considered as the most important part of a plant; for, if any injury happen

to the stem and branches, the roots can still remain unhurt, and enable the plant to revive; whilst, if they are injured to any great extent the whole must wither. A remarkable proof of this was observed in the year 1838: the winter was very severe, and in the month of February the laurels, laurustinus, and other evergreen shrubs, in the gardens around London for several miles, were apparently all destroyed. Many were rooted up and cleared away altogether; but others, which seem equally withered and decayed, were only cut down near the ground, leaving the lower part of the stem and the roots. During the ensuing spring and summer these shrubs sent forth fresh branches and leaves, and resumed their former luxuriant growth and appearance. The frost had not touched the roots, and they had retained the power of life and growth in themselves. A frost may be so severe as to injure the roots; but we see that they can be kept secure from it in the earth, even though all the parts of a plant above ground are destroyed by it. The roots also continue to attract food from the earth at all seasons; even when there is no sign of growth going on above, they

perpetually supply nourishment to the stem and branches, and it is there stored up until the young leaf-buds for the coming spring require it.

We have no proof that roots have the power of selecting favourable juices for absorption; they seem, with very few exceptions, to draw up any fluid that may be in their way. Thus we often see plants apparently poisoned by some injurious matter in the earth around them, if it be only sufficiently liquid to enter the pores of the roots.

Having attained thus much knowledge of the properties of a root, we are led to observe the peculiar fitness of it as an emblem of several good qualities in the Bible. Job, in describing his prosperity, says, "My root was spread out by the waters." The root being the part which obtains moisture, and so conveys nourishment to the whole plant, is the source of its flourishing; and the growth of a tree near water is often remarkably vigorous. It was a favourite image with the ancient writers in the hot countries of the East, where water was scarce, and the effects of drought very apparent. Solomon employed the root in its other meaning, as an emblem of

stability: "The root of the righteous shall not be moved." When David foretold the future growth of Christianity, he said, "Thou didst cause the vine to take deep root." He here uses the vine as an emblem of the gospel, and it is a remarkably good figure to help our understanding. For, when a vine is planted where the roots can spread, and particularly by the side of water, they are known to extend to a very great distance, and thus the vine increases and grows, and is enabled to produce fruit in abundance, and also to endure for a long period of time. An instance of this is well known in the celebrated vine in the garden of Hampton Court Palace, near London. What a wonderful production of rich fruit yearly!—upwards of two thousand clusters of grapes; and this profusion must be chiefly attributed to the vast spread of the roots in a favourable locality, for there is no peculiar advantage of climate or situation, otherwise than in that respect. Truly did David select a proper emblem: how could words written a thousand years before the time have more clearly described the rise and progress, the gradual growth of Christianity? Has it not been

planted and taken deep root in the world, spreading far and wide, hidden in the hearts of men, and rising above in the sight of all, with abundant fruits of faith and love. Scarcely a land is now to be found where the extremity of its branches does not extend, stretching forth its boughs, and bearing fruit to cheer and refresh the weary.

Again, in the New Testament the root was a frequent simile, and chiefly in the sense of a firm foundation, a stronghold. In the parable of the sower, the seed that fell on stony ground had no root, that is, no source of nourishment, therefore it withered. Then St. Paul uses it to explain how the source of nourishment must be right and sound, if the fruit is to be good and valuable: "If the root be holy, so are the branches." How expressive are all these sayings, when we know the real nature and office of a root! "The love of money is the root of all evil;" "Lest any root of bitterness trouble you." How full of meaning are all these allusions; but how imperfectly should we understand them, without some knowledge of the nature and structure of plants.

Now, we will speak of those roots which, besides being of great use to the plants of which they are a part, are of importance as yielding food to man. The common nature of a root is to be hard, tough, and dry, possessing only a very small portion of succulent matter itself, although it serves as a passage for moisture to the whole plant above the ground. In the temperate and cool regions of the earth very few roots are eatable in a wild or natural state. Amongst all the plants of our country scarcely any have eatable roots until they have been cultivated in good soil. The carrot grows wild on the chalk cliffs and fields of the coast of Kent, but its natural root there is small and uneatable; what it has become by the care of gardeners we all know. Instead of a small, tough, tasteless root, it is large, and soft, and tender, contains a considerable proportion of nutritious matter, and an eighth part of saccharine juice. The beetroot is, perhaps, the most striking instance of this capacity of enlargement and improvement, acquiring the immense size of sixty pounds, and so great a portion of saccharine matter, that sugar can be prepared from

it of nearly equal flavour with that extracted from the sugar-cane. The chief quantity of sugar used now in France is derived from beetroot grown in the country. So precious was this root as food for cattle during some years of famine in the beginning of this century in Germany, that it was named "Mangel wurzel," root of scarcity, which name it has retained ever since. The root of beet can also be used as a substitute for malt in brewing beer. The root of the turnip shows in a remarkable degree the improvement to be effected in roots by the skill and art of man in cultivation. In its native state it is uneatable, but artificial soil and long continued attention in the growth of turnips has produced an extraordinary change and increase. It is remarkable that turnips, as well as other plants of the same tribe, flourish much better in open fields than in gardens. Although turnips contain only a very small proportion of really nourishing matter, not more than forty-two parts in one thousand, yet they afford much valuable food both for men and cattle during the winter season. Several varieties are cultivated and

esteemed on the continent which are not known in this country. The parsnip root is another example of the change effected by cultivation. When the plant is found growing wild on the borders of ploughed fields in many parts of England, the root is very small and dry, of a woody nature, and giving no sign of affording nourishing food to man. But after due care in gardens, it was brought to a large size, and became of a succulent, soft nature. These roots are found particularly serviceable in ships for long voyages, as they retain their freshness for some time. Parsnips abound in saccharine juice, but the attempts to extract the sugar as from the beetroot have not been successful. In Guernsey parsnips are considered extremely nourishing food for cows and other cattle. In several parts of Ireland the people use them instead of malt for beer. Some of the properties of the parsnip root exist in the roots of other plants; that of the silverweed, common on road-sides, with its silvery leaves and small yellow flowers, is similar in flavour, though inferior in size and quality. The inhabitants of the barren islands on the west and north of

Scotland are, however, thankful for this humble contribution towards their daily food. In general, the temperate and cooler countries of the world do not afford a rich supply of roots for the nourishment of man, although many have been greatly improved and developed by the skill of the agriculturist. One instance of a useful English root must not be omitted, although it is much less used now than it was formerly. Salep is a beverage prepared from the roots of several kinds of orchis. These plants grow in many of the southern counties of England, most abundantly in Kent, in pastures and on chalk hills and downs; those which grow in meadows furnish the best roots for salep. The chief quantity is now prepared and used in the Levant; probably it is there more nutritious in its nature, for the Turks esteem it highly, and consider it a valuable restorative of health in sickness. After the roots have been washed and dried in an oven, they become almost transparent; when boiled in water, they dissolve into a thick, mucilaginous jelly. Before coffee was so plentiful and cheap in this country as it is now, salep was the favourite morning

drink of those working people who were out early in markets and other places. In the south of France there grows wild a species of artichoke called cardoon, the roots of which, when the plant is carefully cultivated, yield a wholesome and agreeable vegetable. This is occasionally to be met with in English gardens, but is not so generally used as in France, where every species of eatable vegetable is valued. The common arum of our hedges has a root which affords, when dried, a tasteless, mealy powder; this is a wholesome article of food, and when mixed with a little corn flour, might be made into bread. The convict labourers and other poor inhabitants of the Isle of Portland, on the coast of Dorsetshire, use this root as part of their food, and call it Portland sago. If we had not an abundant supply of all kinds of food materials from various tropical countries, this native sago would be more esteemed in London than it is. These roots of several other arums, of larger size, serve as food to the natives of nearly all the Islands of the Pacific Ocean. In many parts of the Himalaya mountains, in the East Indies, the roots of an arum form the

chief food of the hill-people. It is remarkable that in the raw state all these roots contain an exceedingly acrid, unwholesome juice, which is, however, entirely dispersed by cooking with fire. The yams, which are well known as a favourite article of food in the South Sea Islands, are also of the arum tribe; during the scarcity of potatoes in England in 1849, some West India yams were brought here, and were found to serve as an excellent substitute. Batatas, or sweet potatoe, is another important root of the tropics, yielding a very large supply of wholesome food; this plant is of the convolvulus tribe, and bears a beautiful flower. There is one more root of tropical and hot countries which must not be omitted in this account of those which yield food to man, and that is the cassava. The shrub grows in South America, is about three feet high, and is of no value except for the roots. It is very remarkable that even they are unwholesome in a raw state, for a poisonous juice exists throughout the whole plant. But when the roots are prepared by placing them in a fire made in a hole in the ground, the juice flows out, and the flour which

remains after pressure is formed into thin cakes and baked. This cassava bread is the principal food of the inhabitants in many parts of South America. The tapioca, known and used in this country for pudding, is the pulpy part of the fibres of the roots, extracted by washing and boiling, and being rubbed into a grainy substance resembling starch, is sent to Europe with its South American name of tapioca. It forms an extensive article of commerce from Brazil to various countries. Arrow-root is another valuable substance which is obtained from a plant which grows in the West Indies; it contains a very nourishing kind of starchy mucilage, very valuable for children or sick persons, when prepared by boiling. The aromatic properties of plants are most commonly developed in those portions of plants which are above the ground, but occasionally they are found to exist in the roots. The famous ginseng, or "wonder of the earth," is a root growing in China and Tartary; it was anciently supposed to contain in its aromatic qualities a remedy for all diseases. In the present times the Chinese consider it a preservative of health,

and mix it in soup. Owing to its imagined medicinal value, and the difficulty of procuring it from the mountains where it grows, it has been said to have cost its weight in gold.

But there is another aromatic root to be mentioned, of great interest, and that is the nard, or spikenard. It was known and highly esteemed in the most ancient times, long before it was used on that occasion spoken of in the Gospel of St. John, when "Mary took a pound of ointment of spikenard, very costly, and anointed the feet of Jesus, and the house was filled with the odour of the ointment." The value of this "pound of ointment," we are told, was "three hundred pence," that is, a whole year's earning in that time and country, for a penny a day was the usual pay to labourers, and there were not more than three hundred working days in the Jews' year. They carefully abstained from all kinds of work on the Sabbath, and on other holy days also. But what was the reason of the ointment made of spikenard being so very precious, that it was reserved only for the most solemn purposes of anointing, or for extraordinary uses in medicine? A celebrated Greek

physician, who lived immediately after the time of our Saviour, described the plant in his book, which we still possess, as growing in almost inaccessible places on the lofty mountains of Asia, in steep, rocky parts, nine thousand feet high, where it can be obtained only at great risk by the natives. The long roots are covered with dark hairs, which enables them to endure the cold of six months snow, and preserves the plants in a vigorous condition. They are still diligently sought for, and are to be seen in the bazaars of India, where they are sold for the sake of the agreeable scent, as well as for medicinal purposes.

The root of the ginger plant is very generally esteemed for its pleasant as well as wholesome aromatic pungency. When young, it is preserved with sugar; when the stalks have withered, the roots are taken up and preserved in the dry state in which they are commonly used in various ways in medicine and cookery.

Several exceedingly valuable medicines are obtained from roots in hot countries; one of the most useful is rhubarb. The plant grows in Turkey and many parts of Asia, and yields an ample supply of the large roots, which, when

dried, are sent all over the civilized world. All the portions of a plant growing underground, are very commonly called roots, though some are not strictly so, but rather parts of the stem which remain beneath the surface of the earth, instead of rising above it.

The potatoe is generally called a root, yet it is properly a kind of underground stem, as the fact of its containing buds of future plants proves. A potatoe is properly a tuber, or a tuberous root. However, we will speak of it now, for it is one of the most important articles of food in nearly all the temperate countries of the world, where the climate is favourable to its cultivation. It was first brought from North America to England in the reign of Queen Elizabeth; and, although for some years it was not much liked, yet it became gradually generally cultivated and esteemed throughout Europe. There are various other valuable substances derived from the true roots of plants, as well as from those portions of the stem which are below the surface, and are commonly called roots also.

In the hot countries of the world, particularly, roots are developed to great size and value as

food. There also we find curious exceptions to the usual character of a root; in the extensive and beautiful orchis tribe which abounds in South America, the roots, instead of penetrating beneath the ground, grow out into the air,—draw moisture from thence by their sponge-like ends, and twining about branches of trees, support the plants thus, without their having any connection with the earth; they have therefore been named air-plants.

There are none of these kind of plants native in England, but they have now been brought in great numbers and variety from those tropical regions where they grow, and may be seen and examined in all conservatories. Instead of being planted in earth, they are tied by their peculiar shaped short stems on to small blocks of wood, with wire; or are placed in the hollow half of the outer case of a cocoa nut, or perhaps put in a wire-frame basket, and suspended from the roof of the hothouse. A little moss about the roots to keep them moist seems to be all they desire for nourishment, and nothing can exceed the beauty of their wonderful flowers. Many years ago there was a single specimen of

one of these plants, considered a rare curiosity, and shown to all travellers who visited the gardens of the palace at Monza in Lombardy. The gardener, probably, had never heard of them before, for the whole tribe existed in the thick forests of the tropics only, and he spoke of "the air-plant" as a great wonder. Now, we have innumerable examples of these strangely beautiful plants brought from the East and the West, and fresh species are continually being added to our collections.

We have some curious examples of exception from the usual laws of roots in this country. The mistleto has no root in the earth at any time of its growth. The seed is dropped, probably, by a bird, who had taken the soft, white berry for food, on the branch of a tree, and being covered with a gluey, slimy substance, it adheres there, and begins to swell and grow after the usual manner of seeds in the ground. The roots when they come forth penetrate their soft points between the rind and the wood of the branch, and obtain sufficient moisture there to nourish the young mistleto plant. When the leaves appear, this moderate supply of moisture

is still enough, for they have extremely few pores on their surface (only two hundred instead of twenty thousand and upwards, as some leaves have), so do not lose much by evaporation.

Another irregular instance of roots is seen in the little dodder plant. The seed falls into the ground, sprouts there, and sends up the slender, leafless, red stalk, which soon entwines itself around the heath, or other plants growing near. Into these the dodder pierces small teeth, by means of which it is assisted in climbing and clinging on to its neighbour, and is also enabled to absorb juices; thus, living on another plant, it no longer requires a root of its own. The dodder henceforth vegetates, detached from the ground, without a root, and is what is called a parasite plant, like the mistleto.

These last are exceptions, irregular conditions of roots; but according to their appointed plan, perfectly adapted to it, and fulfilling the necessary functions to the plants as completely as those roots which descend into the earth. There is another very singular instance of a parasite plant in this country, to be found in

clover fields in gravel soil. In some seasons there will come amongst the clover countless small plants about eight or ten inches high, brown stalks and leaves, the flowers have a tinge of pale purple and are of the same kind of form as a white nettle. These broomrapes, as they are named, do not appear to have any connection with the clover, they rise out of the ground and stand erect each by itself, though always near to a clover plant. If we take some tool, and remove carefully the earth from about the roots of the broomrape and its next neighbour, the clover, we shall perceive that the two plants are united by their roots. The broomrape attaches itself by the root, and so draws away nourishment from the clover, which dwindles until the crop is worthless. It is remarkable that there are several species of broomrape, but each attacks a peculiar plant. That which grows on clover roots does not attack hemp. The consideration of such instances of order in the midst of an apparent irregularity, cannot fail to impress the mind of a thoughtful student with new ideas of the wisdom and power of the Creator. Not only

do we find wide-extended laws ruling the universe with the same undisturbed power as on the first week of this world's existence, when the Almighty "God saw everything that he had made, and, behold it was very good;" but, in examining the humblest work of his hands, and one which appears to be set apart from the usual course of laws that govern created things, even here also we perceive proofs of infinite skill and unfailing order. One of the lowliest objects in the world, a little rootless herb, nearly concealed amidst the larger plants that compose a tangled mass of vegetation, becomes exalted in our estimation, for it can lead our thoughts—too apt to remain bound to mere earthly things of sight—upwards to the Source of all creation, and help us "to the acknowledgment of the mystery of God, in whom are hid all the treasures of wisdom and knowledge."

CHAPTER IV.

THE STEM.

THE stem of a plant or tree is that part which, as soon as the young shoot has pierced the ground, rises upwards, seeking light, air, and sunshine, whilst the root and its fibres descend into the dark earth. The stem does not rise far above the earth before leaves begin to grow upon it, but with these we have no concern at present. We will first speak of the stem, and consider that very essential portion of a plant, its nature, structure, and office. At first, the stem of all plants, whether herbs or trees, is soft and green; but after some months or years, the various parts of which it is composed are developed, and each becomes perfect and complete.

There are four different ways in which the stem appears above the surface of the ground; that of oaks, elms, and of all the trees or shrubs which are natives in Great Britain, rises only a few inches when a pair of thick, fleshy, oval-

shaped leaves are seen on it. These are called seed-leaves, because they actually existed in the seed itself, as may be easily seen in many seeds you can examine; in that of the almond, or the walnut, when split open, this folded pair of little leaves is quite discernible.

The stem of palms and other trees which grow in the hot countries of the world rise from the seed with only one seed-leaf. We have none of these trees native in our country, but we have many kinds of grass and several other small plants which are called herbs, not trees, all having only one seed-leaf. All sorts of corn, likewise, belong to this large class of plants, which have one leaf on rising out of the seed.

All the trees of the fir tribe have many seed-leaves; not round, thick, and fleshy, like the two which belong to the oak tribe, but slender and narrow like those which form afterwards the foliage of the tree, set on the branches in clusters of three, or five, or in pairs, and are often called needle-shaped leaves.

Then there is one very large class of plants, including ferns, mosses, lichens, mushrooms,

and seaweeds, which have no seed-leaves in their seeds, but spring out of their seeds, at first leafless; each according to its peculiar manner of growth develops itself afterwards to its perfect form, some tribes having a stem and leaves, as the ferns, but others, as lichens, having none. First, let us examine the stem of a young oak, only a few weeks risen out of the ground; it is not larger than that of a small plant; it has its pair of thick seed-leaves with smooth edges, quite unlike the true leaves of the oak, which already have begun to grow on the little stem; they are placed alternately, not opposite each other, and are deeply notched along the edges. But we must not stop to consider this early state of the stem, but look onwards and behold it grown into a lofty tree, having lived through many stormy winters with bare branches, and glowing summers when the strong stem supported the weight of spreading boughs laden with green leaves. If the stem of a full grown oak, or any other tree of this extensive class with two seed-leaves and many branches, be cut through, we find it to consist of several parts all closely bound together. In

the centre of the stem is a small column of a soft substance called pith, this serves as a receptacle for the sap which nourishes the tender parts of a tree during its early growth. Later, it appears to be of little use, for it is found to be shrunk and cracked, often dried up. In the hollow stems of some shrubs, and the stacks of plants of the parsley tribe, it may be seen hanging in little ragged white pieces to the inside of the stem.

If you wish to see an example of pith in its best state, you must search for some rushes, and carefully peel off the thin green rind. This rush-pith was formerly of great use to the poor inhabitants of Ireland and parts of England, for when the rind was taken off, except just a narrow strip on one side to support the pith, and it was dipped in melted tallow, it served as a candle, and burnt very readily. These cheap, common candles were called rushlights, the wick being a rush instead of cotton, as in the better kinds of candles.

The branches of the elderbush, which grows in our fields and hedges, contain a white light pith, very useful when made into little balls,

for some kind of experiments in electricity, and for several other purposes. By the help of the microscope it has been discovered that pith is composed of six-sided cells, like those of the comb which bees make to contain their honey.

In China there grows a tree which has an exceedingly large proportion of delicate white pith; the Chinese cut this up into thin slices around the column, and prepare it carefully with much ingenuity. The material was for many years supposed by the English to be made of rice, and they called it rice-paper. It is only lately that we have discovered the true nature of this delicate substance. On this they paint very skilfully, after their curious fashion, flowers, birds, insects, and other small objects. Thus we perceive that even this apparently insignificant and concealed portion of plants is sought out and applied to some useful purposes. And although rushes were always supposed to be a sign of barren, waste land, springing up in watery places without any care or cultivation, yet they have supplied their appointed help to man, and in times and places when

no other materials for such use were within reach.

But we must now return to the stem of the oak, and examine what else is there besides pith. Next to the column of pith is a kind of sheath which branches out in rays through the wood towards the edge of the stem. These rays are vessels which serve to convey juices from the pith to the young part of the wood next the bark. For in all these kinds of trees with two seed-leaves and many branches, the wood increases at the outer edge. These vessels branch off to every leaf, and passing through its stalk, form that strong rib which runs along the middle of the leaf to its point, and also spreads all over it in fine network. These kinds of branching veins are peculiar to the great class which has two seed-leaves, and are never found in any other division or class of plants.

But again, we must not quit the stem yet; there are many things to consider about it. The wood is the most valuable and important part, not only as the main prop of the tree, but in its enduring use to man. When the tree

has reached its full size, and has acquired a mass of solid wood, it is fit to be cut down, and the stem is sawn up into planks; in this dry state it is called timber. The English oak yields an extremely hard and durable timber, well fitted for building ships. And here we may observe an instance of how beautifully all things are placed where they can be made serviceable to man, to whom in the beginning was given "every herb bearing seed which is upon the face of all the earth, and every tree." The British Isles are not only separated from the vast continent of Europe, but are set in a remote position of the globe, far away from all those hot regions where the principal timber trees grow in wonderful luxuriance. But our native hardy oak has been a compensation to us. In the early times of civilization here, long before the British people had any communication with foreign lands, our oaks were in full vigour, and yielded their timber for the use of the first shipbuilders. We must not imagine they were able to build such magnificent ships as now go out of our ports over the seas to all parts of the world; for, although they had good

hard oak timber, they had not skill and learning sufficient to employ it cleverly: God's gift was ready, but man was not yet prepared to use it well. However, such ships as they could make were valuable to the first voyagers, and in them they bravely sailed over the wide ocean, and so gradually discovered new countries and new timber trees, and by degrees added countless precious woods to our stores. Still, the oak is to be esteemed for many reasons, and is scarcely surpassed for durability. Well, the wood of the stem fills up all the space between the pith and the bark, and forms the largest and most important part of the stem. It is not a solid mass, like stone or marble, but is composed of vessels and cells, invisible to our eyes without the help of the microscope. Though few persons ever see these tubes and cells, yet all can believe they are really there, else how could the water, which we know the roots draw up by their sponge-like points, ascend to the top of the tree, and flow also through all the branches on every side. There must be a free passage for liquid to every part of a tree; for it is quite certain that water is able to flow upwards, that it be-

comes in its passage through branches, stalks, and leaves, changed into sap, and then descends over the whole tree, to the ends of the widest spreading branches and their leaves, nourishing all by its refreshing and invigorating properties; no longer pure water, but sap, the living juice of plants.

If we wish for any easy proof of this fact, let us call to mind what happens very commonly. A geranium, or any other plant, kept in a pot of earth in a room, may be neglected, left without a fresh supply of water for several days perhaps; the leaves have lost their moisture, the little vessels and cells are empty, and have no power to keep in their right position, but droop and appear ready to wither. Water is poured on the earth, soaks through to the roots, they absorb it, and send it up to the plant. In a short time it has passed into every branch and filled all the cells of the leaves, and the whole plant is revived and restored to its original condition. The passages, although hardened by time and the growth of the wood, still remain open as long as the tree is living, however hard the wood becomes.

Throughout all ages of the world wood has been of the greatest use and value to man. To describe the various trees which yield serviceable timber, or to speak of the countless purposes to which wood is applied, is impossible in one short chapter. A few only of the principal woods can be mentioned; and the first foreign wood must be that of which we have the earliest notice in the Bible. The first mention of wood for building is recorded by Moses in the Book of Genesis, in the account of the preparation for the deluge. God commanded Noah to "make an ark of gopher wood." This is believed to be the same as that now called cypress, an evergreen tree which grows naturally in many eastern countries. The stem is straight and erect, bearing many upright branches, with extremely small stiff leaves, laid close pressed together. From the most ancient times it was chosen as a sacred tree, and is to this day always planted in cemeteries, as particularly suitable from its durability and dark green foliage, which never fades. The wood is very fine-grained and hard, and is not liable to injury from insects or weather.

It was peculiarly fitted for such a building as the ark, an immense kind of ship, which was to float on the waters with all its extraordinary cargo of living creatures, and the food necessary for them, during one hundred and fifty days. The ancient Egyptians made their mummy cases of this gopher wood; and the Athenians used it for their coffins. In later times, when it was called cypress wood, it was usually selected for church doors. The first gates of St. Peter's at Rome were made of cypress, in the reign of Constantine, and lasted more than one thousand years. The learned naturalist Pliny, who lived in the first century after Christ, tells us in his writings that the doors of the famous Temple of Diana at Ephesus, of which St. Paul speaks, were made of cypress, and appeared quite fresh when he saw them, already four hundred years old.

The earliest, and very interesting record we have of a traffic in timber, is in the first book of the history of the Kings of Israel. When Solomon had made all ready for the building of the Temple at Jerusalem, he sent to Hiram, King of Tyre and Sidon, saying, "I purpose to

build an house unto the name of the Lord God; now, therefore, command thou that they hew me cedar trees out of Lebanon. There is not among us any that can hew timber like the Sidonians." How readily King Hiram agreed to the whole proposal we find recorded: "I will do all thy desire concerning timber of cedar and timber of fir." Moreover, we read that the manner of transporting timber in those days —that is, two thousand eight hundred and seventy years ago—was the very same as it is now. "My servants shall bring them down from Lebanon unto the sea; and I will convey them by sea in floats unto the place that thou shalt appoint me." In all mountainous countries where trees grow on the hills, the timber is to this day brought down to the sea or river, and then made into floats or rafts, as they are sometimes called. The trees are bound together, and form a long jointed mass of timber. It is very curious to see these long rafts winding their way down the large rivers of Germany, guided by men with long poles. Small huts of wood are built on the raft, and there the families live during the voyage down the Rhine to Hol-

land, or down the Danube to the Black Sea. A very great quantity of wood is thus annually brought from the forests of South Europe. Then we read, further, how Solomon "built the walls of the house within with boards of cedar, and covered the floor of the house with planks of fir; and he made for the door of the temple posts of olive-tree." The wood of the fir is called deal; large quantities are continually sent to England from the forests of Norway, where fir-trees almost cover the lower slopes of the mountains. The wood of the olive-tree is of a hard, durable nature; the stems grow to a great size; and travellers to the Holy Land tell us they have reason to believe that some of the trees now existing on the Mount of Olives are the very same as in the time when our Saviour "went unto the Mount of Olives," to pray and to meditate on the work which His Father had given him to do for the children of men; and from whence, also, having finished His work, he was taken up and a cloud hid Him from His disciples.

The hardest wood known is the lignum vitæ, a native of the West Indies; it is almost black

in the centre and yellow towards the outer edge. In substance it is exceedingly solid and compact, the weight so great that a piece of the wood sinks in water. It grows plentifully in the island of Jamaica, from whence we receive a good supply, and make it into rulers and various small articles that require hard wood. The chief use of it is in the ship-building towns, where a considerable quantity is required for making the blocks, through which the ropes of the rigging pass, the extreme hardness of the wood prevents injury from the friction of the ropes. The cutting of these blocks was formerly a very slow process by hand, but they are now prepared by a machine worked by steam, in an incredibly short time, and with most perfect exactness of shape.

Another very hard wood is the ebony of the East Indies. It is, like the lignum vitæ, black in the centre of the stem, paler and less hard at the edge. No wood takes a finer polish, and it is in every respect well adapted for fine cabinets and inlaid work.

There is one more ornamental wood of the East Indies, well known in this country by

various articles made by ingenious natives and sent over here. The sandal-wood is of a soft texture on the exterior, pale brown colour, and has a delightful scent. The powder is used as incense in the temples of the Hindoos, and also by the Chinese, who carry on a considerable traffic with India in this wood. The inner part, called the heartwood, is most esteemed; so the natives, not having such good tools to work with as an English workman would have, are induced to place billets of the wood in the earth for about two months, when the ants eat away the soft outer part, and leaving the harder centre untouched, they set to work with their rusty tools.

The largest timber tree of the East Indies is the teak; the wood is esteemed equal to that of the oak, and is generally employed for ship-building in Malabar, where the trees grow abundantly on the hills. It is also used for lesser works, tables and other articles of household furniture being constantly made of teak wood in India.

The foreign wood to which we are most accustomed now for our best furniture is the

mahogany from the West Indies, and that tract of country called Honduras in the east part of Central America. Immense forests of mahogany trees exist there, and parties of negroes are continually employed in the labour of cutting down the stems and conveying them to the rivers, from whence they are floated down to the coast of the sea. The work is one of great difficulty, for the trees are of large size and very heavy. About a thousand boys are frequently collected together in one spot, and laborious as the work is, yet the profit is ample, for one tree has been known to produce twelve thousand feet of surface of wood, and to be worth £1000. In Jamaica and other West Indian islands, mahogany is used as a durable wood for beams and boards in houses. Here, it is naturally more costly, and is employed only for tables, cabinets, and such superior kinds of furniture, for the houses of the rich. In the early part of the last century, a log of mahogany was first brought to England, but being found excessively hard, it was set aside as unfit for working. At last a carpenter observed it in a corner of the timber yard, and made a box of it to keep candles in. In process

of time it was ascertained to be an exceedingly valuable wood, fit for the best purposes, being capable of a high polish. Indeed, no wood is so suitable for large tables, and other handsome furniture.

Rose-wood is another fine-grained wood of the tropics, much used for ornamental purposes. A very great variety of woods are now brought to this country from several hot regions of the world, especially from South America; and, no doubt, many remain yet to be discovered and brought forth from the depths of primæval forests

The wood of some trees in the tropics yields a valuable dye; the principal one known and used now is the logwood, a native of Honduras, in forests where the soil is moist. It is a very heavy wood, sinking in water, like the lignum vitæ, and is so hard that it can be well polished. Being chiefly employed for the sake of its colouring juice, or as a medicine, it is brought over in small billets about three feet long. The colouring matter may be made of use for green, purple, and black, when properly combined with chemical preparations. But we must not omit

to speak of our own trees, which afford much useful wood for various purposes quite as essential to our daily comfort, as the beautiful mahogany or rosewood of the tropics.

The wood of the elm, ash, maple, and other trees is all good for several uses; that of elm and ash is particularly well suited for casks, waggons, carriages, palings, and countless other objects. The maple, which is common in hedges in the southern chalk counties, has a peculiar spotted wood, very ornamental for small tables, boxes, and other things.

The sycamore, another British tree, has a white soft wood, useful for bowls, plates, and many household articles.

The wood of the holly is very white and fine grained, and serves to form the outer surface of cabinets, boxes, or desks, which are to be painted and varnished.

The box-tree, hardly more than a shrub, usually about fifteen feet high, affords a valuable supply of hard fine wood, capable of a beautiful polish. This is much used by turners and musical instrument makers. In France it is considered remarkably good for knife-handles,

combs, buttons, and similar small objects of use or ornament. Engravers on wood find it best for their kind of work, and for this use it is now very much required.

The willow affords a wood that is found particularly useful for rural purposes in that part of the country where the trees abound, and furnishes spade-handles and all such agricultural implements. There are some instances of small sized stems being employed whole, or having only the bark peeled off. Osiers are an example of this, their supple nature making them suitable for strong baskets or cradles.

Now we will pass on to the bark, the last and outer circle of the stem. This portion has its allotted duty to perform towards the stem, and, consequently, to the whole tree; it possesses, likewise, many properties valuable to man. The use of it to the tree is to protect it from injury outwardly, and still more essentially to guard the most vital and important part of the stem from the various changes of temperature, as well as damage from accident. Between the hard wood and the bark are the vessels through which principally the juices, or sap, ascend and

descend, and there it is that the growth of new layers of wood takes place. For you will remember, that all the trees and plants of this great class, having two seed-leaves and branching stems, grow and increase on the outside; whilst palms and others in the class, having straight stems and only one seed-leaf, grow internally. The bark is, therefore, an essential part of the stem; and to prove this we may observe the hollow stems of ancient oaks, or elms, or chestnuts, which continue to flourish and send out fresh foliage annually, though but little of the lower stem remains except the bark and outer layers of wood, the heartwood being entirely decayed. The passage for the sap is secure, and that enables the whole tree to vegetate. The rays, of which we have before spoken, as proceeding from the pith, keep up a continual communication between that central part of the stem and the bark at the edge. The beautiful markings and knots in wood are caused by these medullary rays, which vary much in form and substance. Bark is formed yearly in thin layers, the new layer growing next to the wood; in some instances the bark seems to be elastic, and

to increase inside without bursting outwardly; this is the case with an apple-tree. But in the oak, elm, and most of our European trees, the outer bark splits into deep cracks. In the case of the Oriental plane it falls away in broad plates; the thin outer bark of the birch peels off in long strips annually. In some trees the whole covering of bark is thin, but in others it is of considerable thickness. The thin inner layer of the birch bark can be bruised and made into a kind of mealy powder, which the poor peasants of Sweden and Norway are glad to mix with their scanty stores of corn-flour, and make it into thin cakes sufficiently palatable; nearly like oat-cake in taste, but not so nourishing. The Swedes also make a variety of things with bark: boxes and baskets for all sorts of uses. The thickest and softest kind of bark is that of the cork-oak, a tree growing in Spain, Portugal, and other southern countries of Europe. The chief supply for England comes from Catalonia, a province on the east of Spain, where the trees abound. The cutting and preparation of cork affords employment to a large number of the inhabitants. One of the most valuable uses

of cork is for life-preservers at sea; the extreme lightness of the material not only causing it to float on water, but even to enable as great a weight as that of a man to float also. The uses of bark to man are manifold; some of the most valuable medicines are made from it. The tonic, bitter, fever barks of the forests, on the coasts of tropical countries, both in South America and in Africa, not only save the lives of the natives, but are imported into all countries as very excellent restoratives in sickness. Another very great use of bark is found in that of our native oak, from its property of hardening and preserving the skins of animals, converting them into leather. The bark is taken off the stems of oak, two or three years before they are cut down for timber, that the wood may become harder and drier. The bark is then ready for the tanners, and for the various other uses to which it is applicable. After the tannin has been extracted, the remaining dry bits are useful for making hot-beds in gardens, on which to raise young plants. In the isles of the South Pacific Ocean the natives are indebted to the thin inner layer of the bark of the lace-tree, for

the only material at all resembling lace which they can obtain. The fibres of this bark are tough and flexible; instead of cracking they expand into network, and after being soaked in water and stretched, it has much the appearance of coarse lace. From the bark of other plants of this tribe, the natives of Tahiti and others of the southern isles make paper, string, and various useful things. Of some they prepare, by soaking and beating, a strong brownish cloth, which serves for their humble garments; it is not to be compared with our cotton calico, but it is a very ingenious manufacture for such uncivilized people, and the best quality is soft in texture and nearly white; this is reserved for the chiefs of the people.

Now we will pass on to the extensive class of trees and plants with their straight stems and long leaves, with ribs and veins running from one end to the other, neither branched nor netted. Here we find the most noble of all trees, the palms; but they are so numerous, and so abundant in interest, that it would not be possible to speak of them duly at the end of a chapter, they will require more time and atten-

tion. Let us only observe that they conform to the rule of the class in regard to the formation of the stem. No bark, no true wood, but a column of a pithy substance, bound together by strong, tough fibres, passing from the outer edge towards the centre, holding and binding all firmly together. The internal part is not exactly pith, though that of the sago palm resembles it very nearly, and is farinaceous. But no portion of the stem of palms ever becomes hard like real wood, therefore cannot be used for building purposes. When we speak more fully of this majestic tribe we shall discover other valuable materials afforded by it to man. In the south of Africa, a dwarf tree of this class grows very abundantly, the short cylindrical stem covered by stiff leaves. It has been named "Hottentot's bread," because the soft pithy interior is of a mealy nature, and capable of being made into a kind of bread, very acceptable to the poor untaught Hottentots, or the warlike Caffres, who often destroy the slender crops of their fields in fierce fighting.

There is one very interesting plant of this class, which must not be omitted—that is, the

papyrus, a sedge-like plant, which grows in watery places in Palestine, on the shores of the river Nile in Egypt, and elsewhere. The first notice we have of its use is in the second book of the Bible, when the mother of Moses "took an ark of bulrushes," and placed the child in it on the edge of the river. From the observation of travellers, there seems to be no doubt that it was a cradle made of the stem of the papyrus, much in the same manner as our osiers are used in this country. There was another use made of these stems in Egypt; the inner rind was cut into thin strips, which, being laid together in cross rows, were pressed with heavy weights whilst wetted, and thus became closely united, and formed a smooth surface. On this the ancient Egyptians wrote their manuscripts, some of which are preserved to this day in our museums and libraries. In this straight-stemmed class there are numerous examples of various size and form—trees and plants growing in very different climates and situations. From the lofty stem of the Sago Palm, down to the stem of corn which we call straw, there is a bountiful store of materials for the use of man.

One plant, which is highly esteemed, will demand another chapter: the sugar-cane has a long tale to tell, and must have proper notice. Other kinds of cane are also very serviceable; but they belong to the palm tribe, and shall be described on a future occasion.

There remains now only to speak of some very useful substances derived from the stem of trees; and one of these, of most ancient use, is pitch. We read the command to Noah, not only to make "an ark of gopher wood," but also, "rooms shalt thou make in the ark, and shalt pitch it within and without with pitch." Without this the ark could not have resisted the effect of the waters on it; nor could any kind of ship made of wood be preserved from decay, except it was protected in this manner. The fir-tree not only yields us the useful common wood deal, but the stem affords pitch, tar, turpentine, and resin; all of much value for various purposes. There are forests of fir-trees in Scotland, but not sufficient for our use; therefore a large quantity of deal, as well as tar and pitch, is brought here from Norway.

Many trees in the hot countries of the world

have in their stems a peculiar kind of juice, which issues out of the cracks of the bark, and becomes dry and hard in the sun and air. It is then called gum, and is used by dyers in mixing their dyes, by colour-makers in preparing paints for water-colour drawing, and also it is added to some kinds of medicine. We find a good deal in summer oozing out of the stem of plum and cherry-trees in our gardens; but the chief supply comes from Africa, where the inhabitants dissolve it in milk, and make it part of their daily nourishment.

There is a still more valuable juice yielded by the stem of a tree in Guiana, a country of South America. About a hundred and twenty years ago, some ships brought over a new and singular substance, called caoutchouc by the natives, who obtained it by cutting slits in the bark of these trees. The white milky juice, flowing out into vessels made of clay, hardens into a tough elastic substance. At first it was used chiefly to rub out marks made by black-lead pencils; then it was found to be very suitable for tubes and parts of various kinds of instruments. By degrees, it became so useful

and necessary that the trade in this remarkable substance increased extensively. It was discovered also in other countries of South America; in Quito, on the west coast, the inhabitants were found to be acquainted with it, and to use it in preparing a kind of waterproof cloth. The Indians use it also for torches, which burn with a bright light.

The caoutchouc or Indian rubber has now a rival in the nearly similar substance gutta percha, a milky juice exuding from the stems of trees in the south-eastern countries of India, and in Borneo. It differs chiefly from caoutchouc in not being elastic. Two hundred years ago, Tradescant, one of the most enterprising of the early travellers from England, and a collector of curiosities for his museum in London, described a rare thing, which there is every reason to suppose was gutta percha. At that time, the machinery by which it is now rendered available was not invented; nor did many of the uses to which it is now applied exist. It therefore remained amongst his treasures only as an object of curiosity, unperceived by the eyes of wisdom and science, lying useless for a

long period after its first discovery, as if there were an appointed time for all things to come forth into the world for the service of man. The rapid and enormous increase of the imports of gutta percha from Singapore, after its renewed discovery, only a few years ago, is probably unequalled;—from two hundred and thirty pounds in 1844, to one million seven hundred thousand pounds in 1848. The various important uses of this wonderful juice of a tree would take a whole chapter to describe; and many great works could never have been accomplished without it. The marvellous wires which convey messages by means of electricity through the deep waters of the ocean, could not be made secure from injury except they were covered with gutta percha; not even its rival, the first-known caoutchouc, can be used for this purpose. Our daily life also furnishes us with innumerable instances of its use for smaller, yet valuable articles.

There is yet another precious substance obtained from the stem of a tree, which we will speak of before concluding; and that is myrrh, a resinous kind of gum. The trees which pro-

duce it grow in Arabia and other countries of the east; it was in ancient times esteemed for its aromatic properties, and power of preserving from decay, even after death. Thus we find it selected as a choice gift on many occasions; it was amongst the presents which Jacob sent by his sons to Joseph in Egypt. Myrrh also was one of the three things which the wise men presented to the infant Saviour at Bethlehem; and "they gave Him to drink wine mingled with myrrh" in the last solemn hour before the crucifixion.

Now, having considered a few of the endless uses to man of the stem of trees, let us not forget also to remark the value of the stem to the tree itself. It is not only the main support of the whole in upholding the burden of branches, leaves, flowers, and fruit, but it is the great channel of communication from the extreme point of the widest spreading root to the end of the largest branch. From the roots underground to the topmost bough, the stem maintains a free passage for the sap; not an open hollow space, nothing visible to the human eye without the help of a microscope—a series

of minute vessels and cells. This perfect yet invisible system of communication between the stem and the branches explains very clearly to us the full meaning of those words of our Saviour, "I am the vine, ye are the branches; as the branch cannot bear fruit of itself except it abide in the vine; no more can ye, except ye abide in me." "If a man abide not in me, he is cast forth as a branch and is withered: and men gather them, and cast them into the fire, and they are burned." These are words of meaning not to be left unheeded by any one; more especially do they seem spoken to teachers and scholars. If such be the bond of union between the stem and the branches, that no fruit can be produced without it—no, not even life maintained; for, if a branch be broken asunder from the stem, most surely every leaf will wither and fall away—what should be our care to prevent the disunion! If we have a fine branching tree in our garden, how grateful are we for its shelter and shade; how we love its green leaves, its beautiful flowers, its abundant fruit; how grieved we should be if any untimely accident broke away a single branch.

Let us all listen likewise to those words which Christ spoke for our encouragement: "He that abideth in me, and I in him, the same bringeth forth much fruit; if ye abide in me, and my words abide in you, ye shall ask what ye will, and it shall be done unto you."

There are many things hard to be understood, even in those things which we see with our eyes; but when the result of any invisible process is clear to our perceptions, we can have no reasonable doubt of the reality of the work that has been carried on. In these mysterious workings in plants, many facts have of late years been discovered, to enable us to trace out the manner in which the inner life of vegetation is carried on. The grafting of a piece of good apple-tree on the stem of a wild apple growing naturally in a wood, is one of the most ancient and common practices of the art of cultivation. It was done in "the full assurance of hope" that the fruitful juices of the good graft would penetrate into the vessels of the wild tree, and so improve its nature that it would in time bring forth good fruit itself. Now, all this was continually being done long

before the researches of wise naturalists had ascertained that the stem of a tree was composed throughout of hollow tubes and cells, through which the sap flows. Pliny, the learned Roman, who wrote much about plants, knew nothing of the wonderful manner in which the sap circulates in the stem; and yet in his time —the very same time when St. Paul was writing to the Romans—it was a well-known fact that grafting was a truly efficacious process; for St. Paul uses it as a means of explaining to them the mysterious union to be effected by the coming in of the Gentiles. And he concludes by saying, "I would not, brethren, that ye should be ignorant of this mystery, lest ye should be wise in your own conceit."

CHAPTER V.

THE LEAF.

We have now observed the growth of a plant, from the first sprouting of the seed upwards to form the stem, and downwards to produce the root. We have examined the stem; we have seen of what it is composed; we have observed the great importance it is of to the tree itself; and we have spoken of some of the various valuable materials it yields for the use of man.

In all the works of creation we perceive a wonderful unity of parts; nothing stands alone; all things, even if they be apparently different substances, are in some way connected, and working together for good. No one thing in the whole world can be said to be independent of all other things. This is very clearly seen in the examination of a tree; or, indeed, of a plant, of whatever size it may be. We have already described the different portions of a stem—the pith, the wood, the bark; we can separate each of these parts one from the other, so that they

appear to be quite distinct. The bark, more particularly, we may be apt to imagine is a distinct object, and not necessary to the continued prosperity of a tree, because it often cracks, breaks away, and peels off from the stem. Let us proceed further in the study of plants; we may discover something of the history of a tree and its manner of growth, which will show how all parts of a tree in its growing, living state are most closely combined, and are all working for its support and growth.

We will now speak of the leaf and examine its structure; it is a very obvious part of a tree, generally very abundant, and visible to the eye at a distance, when often flowers or fruit may be concealed. The first leaf which appears on a young stem or stalk, as soon as it rises above ground, is called the seed-leaf, because it existed already in the seed. It is generally more or less thick, and has a smooth edge. In all plants of the palm or grass tribe, there is only one of these seed-leaves; in oaks, and all other branching plants, as we have learned before, the reare two seed-leaves, one placed opposite the other in a pair. This pair retains the same oval

shape and fleshy substance, whatever may be the form of the future and real leaves of the tree or plant. It is easy to prove this fact. If you search under a currant bush in the spring, you will probably find many little tiny plants, about two inches high, having a pair of small oval smooth-edged seed-leaves on the stalk, and above them two or three other kinds of leaves divided into five parts, having a notched edge and branching veins. These are the true leaves of the currant bush, and are always of that form. The seedling plants of many of our common trees or bushes furnish instances of this kind. The use of the seed-leaves is clearly to nourish the young plants until they have a few real leaves on their stalks, and can also draw sufficient nourishment out of the earth by their roots. Leaves are fixed to their stalk or branch in various ways; but they always proceed from the rind or bark. Fibres pass through the stalk of the leaf and form the mid-rib; and, in this large tribe we are now considering, they spread over it in a kind of net-work; the cellular tissue of the bark expands also, and covers the frame-work of the leaf. In some plants, the leaves are

united to their branch by a kind of joint at the end of the leaf-stalk; this separates when the leaf withers in autumn, and a scar is left on the branch. A branch of a horse-chestnut shows this very distinctly; we see the two large horse-shoe-shaped scars opposite each other, where the leaf-stalks of a former year grew. There they remain strongly marked, with the dark dots where the tough fibres broke off.

Thus every object in nature has a tale to tell us; its history is written on it legibly, if we will only study it. A bare branch of a tree in winter is able to explain many facts of the past year, as well as to indicate the future by its present condition. The branches of the horse-chestnut do this in a remarkable manner; they not only show the place, size, and strength, of the leaf-stalks, when there are none present, but they prepare their large leaf-buds early in autumn, well covered with sheaths coated with a glutinous resin, and thus foreshow what will be its condition in spring. Some leaves have no stalk, but grow directly from the branch; they are, however, firmly united by the fibres which pass from the inner bark into the leaf. A leaf is not a simple sub-

stance, but is composed of a double skin enclosing the fibrous veins and pulp. This skin or covering is also twofold; the outer is composed of small cells, thin, transparent, and colourless, admitting light to the inner layer of larger cells, which are filled with green pulp. We can prove that a leaf is a double piece—in fact, a bag—by an easy experiment. Take the long smooth-edged leaf of an oleander, soak it in water during several days, till the pulpy part within is dissolved. Then pull out gently by the stalk the strong mid-rib, and press out the pulp; it will then be obvious that the leaf is a hollow bag.

Another experiment nature often performs for us, which shows us, not the outer case empty, but the inner frame-work of fibrous veins. Very frequently in winter, we find on the ground beneath a poplar, some leaves entirely deprived of skin and pulp, nothing left but the fine delicate network of veins, bordered by a firm line around the edge preserving the perfect shape of the leaf. There is a tree in China which has leaves with a very long taper point; the ingenious Chinese have a method of destroying the pulp,

they then paint in their curious style upon the skeleton leaf.

You have now learned how a leaf is formed, of what it is composed, and how it is connected with the rest of the plant. You have discovered that it is not merely an extraneous object, attached to the outside of branches or stalks, but that a leaf is most closely united with the whole system of the plant, whether it be large on a lofty and spreading tree of the forest, or the small slender leaf that belongs to the lowliest herb of the field. The same plan for the development exists, more or less, throughout the whole vegetable world, although the variety of form, and quality, and colour may be endless. In all the branching tribe the first material for the formation of a leaf is, as we have seen, from the interior of the stem. From the woody vessels of the sheath which surrounds the pith and sends out its rays towards the exterior, strong fibres branch out through the bark, and having formed the leaf-stalk, expand into the framework of the leaf. The cellular substance of the bark extends likewise, and spreads over the whole leaf, covering the under surface of the

framework, and then folding over it and uniting with the bark again at the top of the leaf-stalk. Is this formation of a leaf a sudden, or a speedy process? We often hear the remark made in spring, when warm sunny days follow after rain, "The leaves are bursting forth rapidly!" So they do, just at the last, but the preparation for this rapid growth has been going forward during many previous months.

If we examine the branches of a tree in autumn, we may perceive the little conical, hard buds, already there; the formation has begun even before the leaves of the year have withered and fallen away. The small leaf-buds are so closely and firmly folded together, and so well protected by a kind of glutinous moisture, that they will be in no danger of injury from the chills and frosts of winter. They will abide safely till the mild rain of the early spring and the genial rays of the sun call them forth into existence. The first development is very gradual, the outer scales, or sheaths, begin to loosen their hold; the glutinous, resinous substance, melts and yields to the influence of the sun. After the scales have fallen off, the leaves grow

more vigorously; and, at length, when all is duly prepared, and the favourable weather arrives, the leaves do indeed burst forth rapidly, and afford general delight by their beautiful forms and refreshing green hues. Leaves then irresistibly recall to us that everlasting psalm of David, when his heart was filled with thoughts of the mighty power of the Creator, and he spake of the glories of heaven and earth,—the manifold works of the Lord, "Thou renewest the face of the earth." David could not look abroad over the fields of his kingdom of Israel, without a feeling of admiration and praise for the lowly things of earth,—the gifts, equally, of God's bounty, with the exalted things above in the heavens. He omitted not to mention the leaves of plants as a token of the merciful provision made for all living creatures. "He causeth the grass to grow for the cattle, and green herb for the service of man."

Leaves afford an extraordinary variety of form, substance, and properties. Those of the palms are of sufficient size to be used as thatch for the huts of the natives; the leaf of the great fan palm, when spread out, is often as much as

eighteen feet wide; from these gigantic dimensions every size may be observed, down to the slender little leaves of a heath or other minute plant. The properties, too, are of extremely different character; some are composed of strong tough fibres, that not only are fitted to resist the injurious effects of storms or heat in the tropical countries of the world, but render them of great value to the natives. Other leaves are of a soft, tender nature, soon withering under a scorching sun, or being rent by rough winds. Some are very thick and fleshy, containing so much moisture that they require but little help from rain. The thick-leaved cactus of South America can flourish in districts where no rain falls during several months of the year. Another plant has a large thick leaf, from the edge of which young leaf buds are produced, even if the leaf be gathered from the plant and laid upon the ground. The leaves of some plants are smooth on the surface, perfectly glossy; others are covered with fine hairs, or soft down, over the whole surface; these are for the most part found on lofty mountains, or in other exposed situations. Some leaves are only fringed with

hairs at the edges, and are smooth on the upper surface, or on both. Very frequently leaves are downy on one side and not on the other. The hairs of leaves are, moreover, of very different forms, simple, double, tufted, growing directly from the leaf, or seated on a small gland. Some are soft and silky; others, hard and strong enough to pierce the skin of the hand if pressed. The hairs of nettles are spiral, like a corkscrew, therefore easily penetrate and cause the sharp juice, which is in the gland, to rise up into the small wound they have made. The feeling of pain or irritation which this produces is well known. The hairs of some plants are forked, like the head of an arrow, consequently, if they penetrate the skin, it is difficult to extract them. If we hold the leaf of an orange tree before the light we perceive many small transparent dots, these are glands containing a pleasant scented oil, and similar oil glands are found in the flowers and fruit of the orange.

There are some plants growing in this country which are of remarkable neatness and beauty; as, for instance, the different species of St. John's Wort; the leaves of some of these are bordered

by a row of red glands like small beads, on the outer edge. Those aromatic herbs which are much used in cooking to give flavour to food, contain their agreeable properties chiefly in the leaves. Mint, sage, balm, and several more, are in general use, and it appears as if these aromatic qualities enable the leaves to keep in a sound state, for they merely become dry, and do not decay like those of other plants when taken out of the ground. Dry herbs are preserved throughout the winter, and lose nothing of their value.

Besides the various appendages we have mentioned to leaves, there are others to be observed. The edges of many leaves are not smooth and even, but are notched, sometimes deeply; at the points of the notches we find sharp spines, as on the holly or the berberry. Those of the holly are a part of the coat of the leaf, which projects beyond the margin; those of the berberry are formed by the veins passing beyond the edge of the leaf. The leaves of some plants have a tendency to change into spines, as those of the cockspur hawthorn, the spines of which are two inches long.

Water plants are, in general, perfectly smooth on the surface of the leaves, as well as all other parts; but the great waterlily of Guiana, the Victoria, is an exception. The stalks, flower-buds, and the leaves, are thickly beset with sharp spines; the use of this prickly armour seems to be to defend the plants from the attacks of the numerous fishes and other creatures which abound in the rivers of Guiana.

There is yet another object to be noticed in our study of leaves, and that is the pores, mouths, or more properly breathing holes, which are on their surface. Their number varies extremely; the leaf of the rhubarb has as many as forty thousand on a square inch of the under side of the leaf, and one thousand on the upper surface; whilst the mistletoe has only two hundred on each side. They do not exist at all in the leaves of water plants, and are very rare on those of succulent plants, which grow in dry places. There is an obvious difference between the upper and under surface of leaves; doubtless each is adapted to its allotted functions, and there is a curious instance of the manner in which the leaves of a Peruvian plant obey the

laws of nature. They are fixed to the stem with the upper surface of the leaf downwards, but each leaf is twisted at the base and thus presents the right side to the light and air, and so is enabled to fulfil its work for the plant. There are two great divisions of leaves, those which are commonly called evergreen, and those which wither away at the end of the summer. The general colour of leaves is green, but the leaf is the portion of a plant which has the most power of changing its colour; perhaps this may sound strange to you, for it is a common, and in many respects a correct idea, that leaves are always green, though flowers are of every possible hue. Truly the colour of a leaf is green; however, let us examine it from its earliest growth to the end of its existence; we shall discover that it undergoes several changes of colour during its life. The leaves of a lilac bush, whilst still folded together in the bud, and even after they are expanded, are deeply tinged with a red brown tint around the edge, leaving only a pale green in the centre. In the course of a few weeks, the reddish hue disappears; the whole leaf has become a full dark

green. So it is with nearly all leaves, in a greater or less degree. In autumn another change begins to show in the green leaves; every shade of brown, yellow, or red, may be seen in the foliage of trees in different parts of the world. A little plant that grows on some of our highest hills, and covers also many of the elevated districts of the Alps of Switzerland, gives the ground a rich red-brown appearance by the change of its leaves in autumn. The beautiful ash-trees, which flourish remarkably in the Isle of Wight, are no longer green in autumn, but become of the most delicate pale yellow, pure and bright as the colour in some of the fairest flowers. The leaves of our British maple, when growing on a chalk soil, in Kent or Sussex, are of a glowing crimson in the month of October. In the forests of North America the leaves acquire a much greater brilliancy than they do in this country, and give an extraordinary brightness to the scenery. It is evident that these changes depend on the purity of the air in some degree; for in the smoky atmosphere of large cities, leaves dry up and fall off without undergoing any perceptible

change of hue, except what they must suffer from the black particles of smoke which gradually accumulate on their surface. Can we learn how, or in what manner, leaves acquire their green colour? Some portion of this mystery has been unfolded by the continued observation of naturalists. It is obvious that leaves cannot develop their green colour without the help of light; if plants are kept in a dark cellar, the leaves will begin to grow at the right time, but they are weak, soft, and of a pale colour, almost white. When a gardener wishes for tender, bleached vegetables, he knows how to accomplish his desire. The young plants of seakale are kept covered by large earthen pots; the thick stalks and curled leaves thus become tender in substance, and not having their natural properties developed by light, are of delicate flavour. This proves what the skill and observation of man is able to effect. Seakale, when growing in its natural wild state, on the sunny seashore of our southern counties, is hard, tough, and uneatable.

The same care bestowed on celery produces an equally good result. The plants are care-

fully covered with earth, except just at the top. Thus all the acrid, disagreeable properties are prevented from coming into existence, and the plant is kept white and of a mild, agreeable flavour.

That light is essential to the well-being of a plant there is no doubt; for the first effort of a young shoot is to struggle towards it, if it be growing in a situation where light is not general; to the full development of the plant, both in its growth and properties, light is necessary. It is only when the especial use to which man may desire to put it requires it to be kept in an unnatural condition, that darkness is more advantageous than light.

Having now ascertained that leaves are parts, by their formation, of the principal substance of a plant, and that, moreover, they have considerable power of effecting changes in their state and appearance, we may expect to find that they have an important duty to perform towards the maintenance of vigour and life in the whole plant or tree. They are, indeed, active agents of the vegetable kingdom; without them, the water absorbed by the roots could not

suffice to nourish the plant, nor could any part of the process necessary to the perfect development of flowers, fruits, or seeds, be accomplished, without the efficacious help of the leaves. All juices ascend to them, and are by their means chemically changed, during their passage through the cells of the inner layer of the leaf, into sap. This life-juice of the tree is then dispersed into every part of it, causing growth and support, and the completion of the vegetable system.

Here, let us observe how beautifully leaves are fitted for this work; they are expanded into flat pieces, placed in a nearly horizontal position, on the stem or branch, and so expose the fluids contained in their cells to the full influence of the sun and the air. They do all this in a most complete manner, and are, truly, Nature's chemists for the vegetable world. During the hours of daylight, whilst the sun is above the horizon, leaves are continually at work decomposing carbonic acid gas from the air, sending out oxygen gas and retaining carbon for the use of the plant.

In the darkness of night leaves repose, very frequently changing their position at sunset,

drooping on their stalks, and, in some instances, folding up. The wood-sorrel is a good example of this apparently sleeping state of leaves; the three little heart-shaped leaflets are united by very short stalks to the top of the general leaf-stalk; in the daytime this triple leaf stands out horizontally, but at sunset the leaves droop down, and fold together close to the stalk. So regularly does this take place that, even if the plants be kept under a glass shade in a room, there will be no interruption to the remarkable action.

Other leaves have a power of motion of a different kind, and not connected with light. The "sensitive plant," as it has been named, has a long row of small leaflets, arranged on each side of a stalk, in pairs; if the end pair be gently touched, it immediately falls together, and then each pair in succession follows the example, till the whole range is closed. After a few minutes they open again; what gives such a power of contraction and expansion, is not yet discovered.

Another plant, called "Venus's fly-trap," has a very curious leaf, formed of two pieces joined

down the middle by a strong rib; if a fly, or other small insect, light upon the leaf, it shuts up directly, and encloses the insect as in a trap.

The singular "whirling plant," of the East Indies, is in a state of constant motion in its leaves, without being touched, as in the case of the "sensitive plant."

We have said that leaves are always at work for the good of the plant; let us observe one striking proof of this assertion. What is the great result to be desired in one large class of plants, which are very important to us?—The yielding abundant supplies of fruit in their season. Could the various kinds of fruit-trees do this without the help of their leaves?—Certainly not. The flowers may have budded and expanded, and done all their preparatory work duly; but, if the leaves are not ready to carry on the process, there will be no ripe fruit afterwards. The blossoms of the apple, pear, plum, and many other fruit-trees, come forth in early spring, before the leaf-buds are unfolded, but the leaves soon follow, and are fully grown by the time the fruit is formed, and ready for the

juices which they prepare for them. If a leaf be cut off a fig-tree, the fig at the base will not grow or ripen properly.

Having now spoken of the value of leaves to the plant itself, we will consider a few of the chief uses man makes of them, and these uses are threefold, as in other parts of plants; they are valuable to us for clothing, food, and medicine. We may also include another use, and reckon them amongst the materials for dwellings, as in the case of the wood of the stem. In this country you will perceive no instance of leaves affording us help for our habitations, but, remember how varied is the size and quality of plants and their leaves in different countries. In this temperate, cool climate, there are no leaves large enough, or strong enough, for such a purpose. Let us hear from travellers in the tropics what they can tell of the huts of the natives; the roof is covered with the immense leaves of the palms, or the bananas, which grow around their dwellings.

In our own country we are indebted to leaves for several wholesome articles of food of almost daily use. The different kinds of cabbage,

spinach, lettuce, watercress, are amongst the most common. The latter is the only native plant we have which is eaten in its natural, uncultivated state, and uncooked. The leaves of all others have been much enlarged and improved by cultivation in gardens.

Perhaps the most valuable use of leaves to us and to the inhabitants of almost every part of Europe, is that of tea; the leaves of that remarkable shrub being unrivalled in their properties. Of this we will speak more at a future time, but it could not be omitted in any enumeration of the use of leaves to man.

The tobacco plant has also strong properties existing in its leaves, and they are now become of almost universal use; in some ways a real good, in many ways an undoubted cause of evil.

The leaves of some trees contain unwholesome qualities, although the fruit is wholesome, as those of the peach. The bitter flavour of the peach leaf induces cooks to put small bits of it in some articles of food, but the poisonous nature of the prussic acid existing in it renders it a very unsafe practice.

Other leaves are precious to man for their medicinal properties; some are highly aromatic, and some extremely pungent or exceedingly bitter. In the hot regions of the world, plants having these valuable properties are more abundant than they are here; but we have a few that are much esteemed. The bog-bean which grows in marshes or bogs, in some parts of England, has a triple leaf of such intense bitterness, as to make it an excellent means of cure in several kinds of disease.

Our native wormwood is another plant of proverbial bitterness in the leaves, as well as other portions of it, of great medicinal value.

Some leaves yield us a dye for colour; the pear leaf has the power of producing a yellow tint, or a green, when mixed with blue.

Although food is the principal benefit afforded to man by leaves, yet, as I have said before, they do likewise help us in clothing. The delicate fibres obtained from the leaf of the pine-apple have, of late years, been prepared and made into a very fine kind of muslin, in the East Indies. It is almost as glossy as silk, and as thin and transparent as the finest muslin

made from flax. For many hundred years the fruit of the pine-apple has served as food; but the discovery of the use of the leaves was reserved for this century of observation and ingenuity.

The aloes of Mexico yield to the native Mexicans numerous articles from the thick, fleshy leaves. Of the strong fibres they make ropes, string for fishing-nets, various kinds of clothing material, coarse and fine. Of the juice they prepare their favourite beverage in daily use. The leaves being armed with stout spines at their edges, make the plants an impenetrable fence to their fields and plantations; the spines themselves are converted into needles, and the fibres into thread. In Africa the Negroes and Hottentots make as much use of the aloes as the Mexicans do; there is a range of low hills, near the Cape of Good Hope, nearly covered with different kinds of aloes, for these succulent leaved plants grow best in dry, sandy situations. On the barren parts of the Mediterranean coast of Italy and Spain, aloes are the principal plant, and are extremely useful. The fibres are prepared in various ways; a violet dye is obtained

from the juice; a kind of soap, also, for washing; a medicine; a varnish; and countless other lesser uses of much value.

Now let us notice the use of leaves as food to cattle. Grass was, in the origin of all things in this world, given to them as their appointed food; and so it is still, and ever will be; and most abundantly is the provision made. No other plant covers so extensive a portion of the surface of the earth, or yields so continual a supply of fodder; and this not only in places set apart as pasturage, but in the rough places, by the wayside, on the mountains. Ever since "God said, Let the earth bring forth grass," it has obeyed the everlasting command; the tender leaf springeth up wherever there is a spare place for it, and is ever ready for the cattle that pass by. This is but one instance of the food yielded by leaves to animals; we cannot know them all, if we would: if we were to spend days and months on the study, we could not describe all the innumerable ways in which leaves feed living creatures. One single leaf may afford nourishment to many minute insects; and countless numbers devour the leaves of every kind of

plant. We are acquainted with some very striking instances of the voracious appetite of insects for leaves; we read in the book of Exodus how "the locusts went up over the land of Egypt,—and very grievous were they; they did eat every herb of the land, and there remained not any green thing in the trees, or in the herbs of the field, through all the land of Egypt." And we know at the present time that silkworms feed entirely on the leaves of the mulberry-tree; and, large as they are, they soon disappear in this manner.

When there occurs what is called a blight, in spring, we see the foliage of tall trees stripped in the course of a few days or nights; for swarms of invisible insects frequently arrive, no one knows whence or how, and devour leaves with incredible avidity.

Besides the endless variety existing in the form and quality of leaves, there is also very striking difference in their stalks. In some examples of the acacia tribe, in Australia, the leaf-stalk is so much developed, as to be able to assume all the duties of a real leaf. At first it bears a double row of small leaflets

at the end, but in a few years these all vanish, and nothing remains but the flat, oval stalk, with long veins from end to end. This is a singular fact, and the transformed stalk-leaf appears as an irregularity in the vast class which has in general netted branching veins in the leaves. The leaf-stalks of some water plants of the tropics are expanded into a hollow bladder, which greatly assists the leaves to float. The curious "pitcher-plant" of China has its leaf-stalk in the form of a vessel capable of holding liquid, the true leaf being fixed by a sort of hinge to the top, like a lid. The leaf-stalks of some of the pea tribe have flat leaf-like sides, and are called winged-stalks. Other leaf-stalks are much lengthened, and curl round any object in the way, like the tendrils of the vine, and many well-known climbing plants. Leaves of grasses have no actual stalk, but a long sheath which embraces the stem, ending usually in two small membranous points at the base of the leaf. The leaves of all this large class of plants are united to their stem in a peculiar manner, unlike any of the various ways of the branching class. Those of palms

are generally bound on to the stem by strong fibrous sheaths; of these we shall learn more in a future chapter.

Before we dismiss this subject of leaves, let us first consider if there be yet any other lesson they can teach us. We have ascertained that they are very wonderfully made, and are very important objects to plants and to mankind. All things are full of meaning to us, if we can only discover it. Surely leaves are so in no slight degree; they speak to us many things very plainly, in a language all may understand if they will. As in all other works of creation, they help us to comprehend something of the wisdom and goodness of the Creator; the visible things that are made, enable us to penetrate a little further into the invisible things of God than we could otherwise do.

The whole history of a leaf is, as we have seen, very remarkable; it has afforded interest and instruction in some manner throughout all ages. In some countries there linger old traditions. The Welsh have an ancient veneration for the number three; their bards used to compose what they called triads, or three things

worthy to be remembered. The Swiss also have a custom of placing subjects or events in three-fold union. We may do this with plants —they have leaves, flowers, and fruit; these three things may be justly compared with our thoughts, words, and actions. We perceive that leaves are ever working out much good, that no essential part of a tree can come to perfection without them; all would remain in an undeveloped and useless condition. So likewise is it with us; if our thoughts are not diligently set to work on any subject, it can come to no perfection—it will produce no beneficial results, either in words or in deeds. We may remark, also, another similitude: a tree may, and often does, bring forth leaves plentifully, but produces no flowers or fruit; therefore, if it be one which ought by its nature to be fruitful, yet bears no fruit, it is cut down, not suffered to cumber the ground. So likewise with our thoughts; if they lead not to good words or actions, of what value are they to our fellow-creatures? Recollect the warning of the barren fig-tree. He who once said, "Ye shall know them by their

fruits"—"He came to it and found nothing thereon but leaves only;" and presently the life-sap of the fig-tree was withheld, and it withered away.

The first garments were made of leaves; then a leaf was the token to Noah of the abatement of the waters after the flood. Throughout the whole volume of the Holy Scriptures, a leaf is employed as an emblem of some higher signification: the trembling of heart of those who have broken God's commandments, who have not kept his Sabbaths, is very touchingly represented by the idea—"The sound of a shaken leaf shall chase them." We image to our minds immediately the aspen leaf, with its flattened stalk set on sideways instead of the usual way, so that the slightest breeze puts it in motion, and causes a peculiar rustling sound. Then David, wishing to describe the flourishing state of a good man, says: "His leaf shall not wither." We think of the bright laurels, with their glossy leaves green through summer and winter, affording an unfailing shade and shelter.

There are, indeed, many allusions to leaves and their significance to us; but we shall never

understand them unless we first learn the nature, office, and properties of leaves. How beautiful and consoling is that description, in the last chapter of the Bible, which St. John has recorded in his vision of the heavenly city: "On either side of the river was there the tree of life; and the leaves were for the healing of the nations." We can now appreciate the deep meaning of this expression. Leaves, the most abundant and wide-spread objects of nature that could have been selected for an emblem; as if to declare the unbounded love that has prepared the means of our being healed—made whole. We can reflect upon the unlimited store of salutary properties contained in them; does not this indicate in unmistakable clearness what is the healing that is graciously provided "for all nations?" It can never be exhausted, but will be renewed as long as time shall last.

CHAPTER VI.

THE FLOWER.

We are now come, in our studies of plants, to that portion which is acknowledged to be the most perfect in the arrangement of its parts, and the most beautiful to behold. A flower is by universal consent acknowledged to be so excellent in design, and so lovely in the endless variety of its form and colour, that it has become a type of all earthly perfection and beauty. If any object whatever is to be described as in its prime, a flower affords the most natural emblem to express its state. The ingenuity of man is exercised on the cultivation of flowers in all the civilized countries of the world; and it is remarkable that a love and admiration of flowers is one of the most prevailing feelings implanted in the human mind. One of the earliest signs of a dawning sense of delight in a little child, is called forth by the sight of flowers. Is it not one of the first simple pleasures of childhood to go forth into a field or garden, and gather daisies

or wild flowers? This is an unfailing source of innocent joy to the youth of one generation after another. It is, moreover, a sure token of progress in the comforts of civilized life, when flowers receive some share of attention and care. Colonists in a new country work diligently for some years, clearing the wild ground, sowing corn and other crops for food, no time or thought to bestow on flowers merely as ornaments or pleasant additions to their new abodes. But what happens in the due course of time, when fields and crops are established, and the settlers begin to rest from their harder toils, and have leisure to recall their former ideas of home and the refinements of life? Just this, which I heard lately from an English family, now prosperous in an estate they have themselves brought into cultivation in New Zealand. "Next season we hope to begin the English custom of sending flowers to market for sale in the towns." This speaks as clearly of advancement as any message that could have been sent; and we figure to ourselves the gay garden, with its neat flower-borders, helping forward very efficiently the great work of civilization in the far-off land of

the Southern Hemisphere. Are there not, also, many in the remote districts of our own island, who could bear witness to the same truth. A cottage flower garden is one of the surest means of improving the condition of the poor; it not only forms one of the most pleasing sights of this favoured country, but it is a certain proof that all is well with the owners; it is an indication of industry and cheerfulness, and all those qualities which are the best characteristics of the British peasant.

But we will now examine what a flower is, how it is composed, and of what especial value it is to the plant. The variety of form and colour in flowers is so endless, that it is difficult to believe there is only one plan or purpose existing throughout the vast range of the world of flowers. Yet, true it is that all the apparent differences are destined to the same end, and all perform the same work.

The flower is that part of a plant which contains the future seed; it is composed generally of four parts, an outer green piece, more or less divided into points; an inner coloured piece; the central column with the germ of the future

seed or seeds at its base; and the cases full of powder standing around it, usually called stamens. Of the central part of a flower the use is obvious; for the production of seed is the principal result to be obtained from all plants. The use of the outer rows to the flower seems to be to protect the future seed whilst in its tender, undeveloped state, to shelter it from the injury of weather or of insects. How well adapted they are for this purpose, we can perceive by examining any flower-bud that may be in our path; for, however varied be the form, yet all flowers are arranged for their appointed end. The future little seed is enclosed in a case called the seed-vessel; this is placed almost invariably in the safest part—in the centre. Then the threads with their powder cases are bent over it closely; the coloured pieces, called petals, are folded with the most perfect order and regularity over them; and the green outer covering, called the calyx, from a Latin word meaning a cup, wraps up the whole bud.

In the chapter on leaves, we discovered how slowly and carefully they are formed; what a gradual process they pass through before they

adorn a tree in countless numbers with their symmetrical forms and refreshing green hues. The whole winter is spent in preparing their fine yet strong framework, their peculiar substance, juices, and colour.

We shall not be surprised to find the same forethought shown in the preparation of a flower-bud; for, though we have ascertained that neither flowers nor fruit can be perfected without the help of leaves, yet undoubtedly the flower, and its result, the fruit, are the most valuable part of the whole vegetable race. One of the most remarkable instances to be found of this careful preparation for the future, is to be seen in the rhododendron of North America, now so general an inhabitant of our gardens. Almost as soon as the flowers of one summer are withered and fallen off, the small green buds of the next year's flowers are visible on the fresh formed shoots at the ends of the branches. And here let us observe how clearly they indicate to us the yearly growth of the shrub; for, at the end of each branch, there are two or three new stalks terminated by a bud. This bud is still hard, and clothed with its green scales firmly pressed

together, folded one over the other. If you cut open one of these buds in the month of October, what will you find? The whole bud is not so much as an inch across; yet you will perceive within the secure covering of the green scales the entire cluster of blossoms, ready formed, each flower distinctly visible. Open one of them carefully, and there is the delicate pale flower, still very small in size, with its five deep divisions, crumpled and packed into the closest possible space. Within are the ten long stamens, the threads we have already spoken of, curled up, and bearing each its case of powder—the anther, as it is called. And what is very remarkable is, that these anthers, on which the whole power and fertility of the seed depends, are full grown, they have already attained their perfect size. Beneath them lies the small conical seed-vessel with its long slender column rolled up. All this exquisite work will remain dormant during the long winter months, until the midsummer sun of the following June shall shine upon it, and cause the flowers to burst their leafy scales and expand in brilliant beauty.

This is an example of a flower deeply cut into

five parts at the top, united at the base into a short tube; when its work is completed, and the seed-vessel secure in growth, it falls off in one piece from the top of the stalk, leaving the seed-vessel behind. The outer green part, or calyx, is very small, but divided also into five points; this remains beneath the seed-vessel. The rhododendron is an evergreen shrub; therefore it has time and power to make this long preparation for its flowers. Those plants which are called herbs, and spring up anew each year in spring, must have a different plan of unfolding their flower-buds.

We will now examine another kind of flower, one which grows very plentifully in green fields almost everywhere. You all know the yellow buttercups, which shine like gold amidst the grass in the month of May. We see nothing of them all the winter; for, though the roots are still in the ground, the stalks, leaves, and flowers, have all withered away and disappeared. In spring a new life comes into all plants; young tender stalks appear; and then, in due time, leaves and flower-buds. Let us take a buttercup, and see how it is made; it has a very different

plan from the rhododendron. At the top of each flower-stalk there is first the calyx or cup, with its five small green pointed leaves. Above that we see five yellow petals of a round shape; they are fixed to their place by a small part only, and can be easily pulled off separately. In the centre there is a round mass of pale green objects; these are the seeds, each one in a little case, and all united together; around them stand numerous short threads, with their anthers full of powder—not a certain number, as in the rhododendron, which has always ten. There is one more minute object to notice in this flower. Examine the bright glossy petals, and you will find at the base of each a small scale; this is called a nectary or honey-cup, and is to be found in many flowers, of various kinds of shape. Thus you perceive that a common buttercup contains a clear proof of order and arrangement of parts, all according to the one comprehensive plan which regulates the whole race of flowers, but having a peculiar character of its own, which distinguishes it from all other flowers. It would be impossible to mistake a buttercup for any other flower; even a young child, who had

never been taught to examine its structure as you have to-day, knows it well, and could seek it out from amongst many other flowers in the same field without the least doubt. A buttercup is so decided in its character, that it has been made the chief of a whole tribe of plants; not only of several kinds of true buttercups, but of many others which very nearly resemble it in form and structure. The common field buttercup is the best known. There are several more which have the same name, but are varied in some things; one kind has a slender narrow leaf instead of one divided into five parts, and grows in watery places, not in meadows. The brilliant little buttercup, which shines like golden stars in April, has its flower parted into many narrow petals, instead of five; and the leaves are not only of a different shape, but are bright and glossy, instead of being dull and hairy like those of the common field buttercup: still, it is clearly of the same tribe. Thus we are enabled to class many plants into one set or tribe, and so can learn their history and character more readily, and recognise them easily when we meet with one of them.

Now, I will give you an example of another plan for a flower; those you have already examined were what we call single flowers, but contain each several seeds. What is the arrangement of the common white daisy? Everybody knows that pretty white flower, with its yellow centre; and would be sure to remember it, if they were to meet with it unexpectedly in any other country of the world. But it is one thing to know an object by sight, and another to understand its various parts, and the reason of its being arranged in its own especial manner. As usual, the outer parts are meant to protect the inner portion in its early state of existence; if you gather a daisy whilst still in the bud state, you see it is a little round ball—the whole folded up snug together. When fully grown and open, we perceive first, at the top of the stalk, the flattened cup formed of ten or twelve small green points—not five, as in that of the buttercup. Then follows a circle of delicate, narrow, white florets, quite flat, except at the end, by which they are fastened on; that is folded, and contains one thread-like pistil with a seed at the base. The central, yellow part, is composed of

numerous little flowers, each one perfect in itself, different from the flat, white florets at the edge; for they are formed into a tube at the base, and spread out at the top into an elegant vase-like shape, parted into five little points. Each of these is a distinct flower, and contains a seed at the bottom, with the slender column rising from it to the top of the floret. Close around it stand the stamens, their powder-cases united round the upper part of the column, or style, as it is sometimes called. If you could examine these florets with a magnifying glass, you would be surprised at the graceful beauty of their form; and although, from your earliest childhood, you may have been delighted to see, and to gather the favourite daisies, you would feel a still higher sense of enjoyment, when you have thus acquired a more complete understanding of their plan and structure. A daisy is, as you now know, not a single flower, but composed of many florets, as we call them, each one perfect, and the whole forming a compound flower.

There are many more flowers of this class, growing naturally in our fields and woods. All who have the opportunity will do well to search

out examples, and endeavour to trace out the plan of their formation. There is the wild chamomile, often found in corn-fields; and the yellow ragwort, which grows almost everywhere in rough places and hedges.

All kinds of thistles are also of this tribe; only they differ from the daisy in having all the florets of the same kind, none of them flat, like those of the rays of the daisy.

Then you can readily find examples of compound flowers like the common dandelion, of which all the florets are flat, none of them tubular.

There are some flowers which have each only one seed; to this class belongs the dock and sorrel, and a few others. All flowers do not have petals; either the green calyx becomes coloured, and assumes the appearance of a real flower, or it remains green and there is no coloured part at all. To this last class belong the dock and sorrel.

The large trees, such as oaks, elms, ash, and others, have no coloured flower; but the essential parts of a flower,—the preparations for the seed are there, and carefully protected by small,

green, leafy scales, usually placed all together on stalks and forming various combinations.

It will be impossible to describe all these countless varieties, but you must each strive to seek them out for yourselves. In the early spring they generally come forth before the leaf-buds are expanded, and are, therefore, easily to be seen.

As soon as March arrives, the blossoms of the hazelnut begin to appear, and hang in long, clustered rows, drooping on the bare branches, singly, or in pairs, or threes; the nuts do not, however, come from these long clusters of flowers, but proceed from shorter oval buds. The leafy part, which enlarges and remains on the nuts after they are ripe, is the calyx. We watch with greater anxiety for the appearance of some flowers than we do for others; some are merely pleasant to the sight, and, possibly, agreeable also for their fragrant scent. Others we esteem because they are a sign of future food, as fruit, or of what is commonly called vegetables.

The different kinds of fruit-bearing trees in this country have nearly all the same form of flower, but are divided into two classes. The

blossom of the apple, pear, quince, medlar, gooseberry, and currant, is of the same character, in one respect, that is, it is placed above the top of the future fruit. This you may prove, if you know only the fruits, and never saw the flowers, for the remains of the withered calyx is left on the top of the fruit.

The blossom of peaches, almonds, cherries, and plums, is below the fruit; therefore, when it is withered and fallen off there is no trace of it left on the ripe fruit. As you know, they are all smooth and round over the top. They are, however, all alike in some things; the calyx is always composed of one piece parted into five points, then comes the coloured row of petals, five in number, and pink or white in hue. Within are numerous stamens, very slender threads,—bearing their roundish cases of pollen, as the powder is very often called. In the middle we find the future fruit, with the column above, if it be a peach, or a plum, or a cherry, or an almond blossom. But if we examine an apple, or a pear, there will be only the top of the column visible, for the future fruit is below the petals, stamens, and calyx.

I have said that the word calyx means cup. Now, that of a buttercup, or of a daisy, is so nearly flat, that you may not perceive any resemblance to a cup.

Let us look at some other flowers which are readily to be found in our fields, and we shall soon see that the name is well chosen in general. Take the flower of the common dead nettle, that which does not sting. It has white flowers set in a circle around the stalk; each one has a short stalk of its own, and, at the end, is a small, green, cup-shaped calyx, divided into five small points at the top. Out of this cup proceeds the white part of the flower, which is a narrow tube in the lower part, widening at the top, and parted into four divisions, one piece standing upright, the other three bending downwards. There are many flowers with just the same arrangement, others, with only slight variation. Mint, horehound, and a few more may be seen in summer, abundant on hedge-banks and waysides.

In former chapters we have observed the two large classes into which all flowering plants are arranged. One, having two seed-leaves and branching stems; the other, with only one

seed-leaf, and a straight unbranched stem or stalk.

All the flowers we have now spoken of belong to the first of these two classes; and you may remember one rule, by which to ascertain their class, even if you only have a flower to examine, and no other portion of the plant. If it belong to the first class, the parts of the flower will be either five, or four, or more, but never three or six. The petals of the buttercup are five, the green points of the calyx are five. The little yellow florets of the daisy are divided into five points at the top, and their stamens are five in number.

The flowers of the larger portion of our most common native flowers have five petals and five stamens. The bluebell or campanula, the forget-me-not, the scarlet shepherd's clock, and many others, which we cannot describe now. The tribe containing the white dead nettle, has a tubular flower divided into four at the open part, and four stamens within the tube.

The plantain, which affords food to birds, with its numerous small seeds, has a four-leaved calyx, four petals, and four stamens.

There is, also, a very extensive tribe of plants, the flowers of which have invariably four petals, placed opposite each other, crosswise. Our native watercress, all kinds of cabbage, horse-radish, turnip, colewort, and several others, all belong to this cross-flowered tribe, and have four long stamens and two shorter ones; thus forming the number six, which seems an exception to the rule before mentioned, but there is, evidently, an irregularity, as they are not all of equal length. This branching class of plants is the most prevailing in our country, and can be readily procured for examination.

Our gardens, however, furnish us with several very beautiful specimens of that class which has single stems, and the parts of the flower, of the number three. But it is better we should take an example from our own fields, if we can. If we search in a few favoured spots in Westmoreland, we may find in the month of April the yellow daffodil rising straight out of the ground, surrounded by a few narrow long leaves. The flower is placed at the top of the stem, protected at first by a brown membranous sheath; the lower part of the flower is a slender tube, at the

bottom of which lies the future seed-vessel; at the top of the tube the flower spreads out into six deep divisions, which surround a hollow cup. This cup is called a nectary; within it are six stamens, and the long column proceeding from the top of the seed-vessel. All the varieties of daffodil and narcissus are according to this arrangement. How many admire the bright yellow daffodils, or the pure white narcissus and its golden cup, without having once examined the interior, or ascertained in what way the chief object of care and forethought, the seed, is provided for.

We must, indeed, speak of the seed as the chief part in all plants; although, in this instance, it is not in reality of so much value as in many others, for the roots multiply and increase the plants in sufficient number. In the sheltered woods on the hills of the quiet Craven district of Yorkshire, there is another delightful example of this class. The delicious-scented lily of the valley has its elegant little bell-shaped flower parted into six small points; the stamens are six, and the seed-vessel has three partitions. All is in conformity with the extensive rule, the

green leaves are straight, and their veins run direct from one end to the other.

Another very beautiful specimen is the blue hyacinth, which adorns many parts of our country most abundantly in spring; the nodding flowers have six petals, curled backwards; the stamens are six, and the seed-vessel has three cells.

The graceful snowdrop, the striped tulip, the countless rich-coloured lilies from all parts of the world, that embellish our gardens, are all in this very beautiful class, and afford a large share of ornament and delight. You may examine any one of these that you may be able to find; there will be the same plan in all; there will be no outer green part to the flower, the outer and the inner row will be so nearly alike that you will scarcely perceive any difference, unless you observe very carefully.

Take a tulip; there are three of the petals outside the other three, and rather larger than they are, placed just a little lower down on the stalk; then comes a circle of stamens, six in number, with their very large anthers full of pollen; the seed-vessel, divided into three cells,

stands in the centre. The arrangement of the flower in all this class is extremely simple and beautiful, less liable to variation than in the other.

One great change in the appearance of flowers, is caused by their becoming what we call double; but is, in fact, manifold. Tulips are sometimes increased in this manner, as we see in the little early Dutch tulips; but it is a rare occurrence amongst these flowers. In the class of which we first spoke it happens often. A rose in its natural state is composed of five petals only, but all those which are cultivated in gardens have numerous petals lying one within the other.

Various other flowers are common in this state; that of the cherry, when double, shows very clearly the true nature of the several parts, and that all are, in reality, transformations of leaves; for the pistil, or seed-vessel, is often only a folded leaf, and stamens are seen in a half state, partly a petal, and the anther sometimes fixed to that, instead of to a thread.

The large, red double peony is a remarkable instance of this gradual process of transforma-

tion: the green leaves towards the upper part of the stem become by degrees smaller, less divided into parts, the last quite simple; and then they become petals, and of a bright crimson instead of green. Petals and stamens are linked together in gradual approach to change, and the two seed-vessels in the centre are clearly from the same source as leaves.

I have said, in the beginning of this work, that the study of plants is a vast subject; that, to an inexperienced student, it may appear almost impossible to gain an accurate knowledge of the immense number and variety of plants that exist on the surface of the earth, besides all those which flourish in water. It may seem as if it must be a perplexity, rather than a pleasure. It may seem so at first; but, remember, that the happiness brought to our minds by study is not the coming to an end of any subject, but in the actual occupation of learning. And in the study of flowers, it is remarkable how much interest and pleasure is derived from the observation of their structure, and the wonderful proofs of wisdom they afford.

Who does not delight in seeing the crocus

appear above ground in spring? No one could fail to admire them; planted, as they generally are, in rows,—bordering the bare earth with purple, white, and gold; simple in form, brilliant in colour, they meet with a glad welcome from all who have eyes to see, or minds to perceive the marvellous works of God. But, surely, we shall experience a more refined pleasure and satisfaction if we can learn something of internal arrangement and plan. Take up a crocus out of the ground; the root is round, from the base grow several fibres, the use of which you have already learnt. From the top proceeds the single stem, clothed with alternate pale-brown scales. At the summit of the stem are a few long, narrow striped, green leaves, and from the midst of them springs the flower, the part which we now wish particularly to examine. There are the three outer and the three inner petals; within these are the three stamens,—long threads attached partly to the sides of the tube of the flowers. For though we spoke of the flower being at the top of the stem, let us split it open down to the root: we then perceive that the tube of the flower springs from

thence, and the column rises from the three-sided seed-vessel below and terminates in three small horns in the open part of the flower above; the powder of the anthers enters at the top of the hollow column, and passes down it to the seed-vessel below. What a curious provision for the formation of the seed! How much is going on in the crocus of which those who merely admire the bright flowers know and think nothing! So it is with all the works of creation; the more we inspect and study them, the more we perceive the marvellous power which ordereth all things, and the true wisdom which fits each portion to its appointed end and purpose.

In a tribe very nearly resembling this, in which the crocus is found, there is a plant of much interest to us occasionally to be seen in our flower gardens. It is a native of the fields of Judea; and by travellers, who have seen it growing there in profusion, it is believed to be the same flower which afforded an object of instruction to the disciples of our Lord. When he bid them "consider the lilies of the field," and observe how their glory surpassed that of the richest royal garments, we can imagine it to

have been an impressive lesson to them; in the brilliant light of an Eastern climate, the flowers must be even more resplendent than they are here, and would shine in the glowing sun like pure gold. Many of the most graceful and beautiful flowers that exist are in this wide-extended lily tribe. The tall white lily of the East has been by general consent admitted to be an emblem of innocence and purity, and was so employed by the greatest painters of the past ages.

Besides the numerous examples of flowers worthy of admiration, for the beauty of their form and colour, in this great class, we must notice the smaller and uncoloured flowers of the vast tribe including corn and grasses. From the minute size and short duration of these blossoms, they obtain very little notice, even from those who walk through the fields during their brief existence. Yet the fragile flower of grass is well worthy of examination. Take any example that is at hand during a walk, open it slowly; you will perceive, instead of the usual plan of a calyx and petals, that there are two outer scales, or pointed leaflets, folded sharply;

then two other rows within, rather higher upon the stalk, one of which has frequently a kind of bristle at or near the top; two other pale, oval, little scales, stand immediately at the base of the small seed in the interior; this terminates in a column parted into two feathery ends, which receive the powder cast upon them by the anthers of the three extremely slender threads, which proceed from the base of the seed, within the two inner scales. As soon as the anthers have shed their pollen, the delicate threads wither and vanish, fully explaining to us the meaning of that description of the uncertain state of the rich, "as the flower of grass he shall pass away."

The variety of grasses is very great, as any one may perceive in passing through a hay-field in this country. In the warmer regions we should find a still more varied form, both in the flower and in the general manner of growth; yet the type will be the same. The want of calyx, or coloured petals, and the presence of three fragile stamens, are unfailing signs of the flower of grass or corn. Even in our native land there are many striking

examples of the unlimited variations that occur in the development of one vast, yet simple plan.

The humble meadow grass, when in its full growth, and having its flower-stalk risen to its complete height, is not more than seven or eight inches above the ground.

The great reed grass, which flourishes luxuriantly in ditches near the mouth of the Thames, has a stem, and branching cluster of flowers, as much as six or seven feet in height.

Sedges, rushes, and many other plants which grow in watery places, have their flowers precisely after the same plan, although the growth and aspect of the whole plant differ in each.

The greatest difference to be observed in plants of one tribe, in regard to the arrangement of parts in the flower, is between wheat and maize, or Indian corn. The flowers of wheat are placed at the top of a simple stem; those of maize are of two kinds, the flowers bearing the stamens forming a spreading, feathery, drooping cluster, at the top of the main stem; whilst those which produce the seed are closely united on short, erect stalks, at the base of the large leaves on the stem.

When we come to describe the palms, we shall find much similarity in respect of the number of the parts of the flower, both with lilies and grasses; three is, with the noble race of palms, the chief number, as we have found it to be in the lowly grass of our pastures.

There is another very remarkable tribe of plants, of which I should like to speak to you, before we conclude this description of some of the chief examples of the large class, with its straight stems and straight-veined leaves. Perhaps you will not discover the connection, if you look at some of the wonderful and strangely developed forms to be seen now in the conservatories of this country.

But let us take a simple specimen from one of our meadows in the month of May. The purple meadow orchis will show us the nature of this curious tribe; the flower has two rows of coloured parts—the outer one divided into three pieces, the inner one also, one piece usually changed into a horn or spur. The column in the centre is enlarged by the union of three stamens to it; the seed-vessel, when ripe, is filled with innumerable minute seeds.

But this simple plan is changed and varied in appearance more than in any other tribe of plants. Our little meadow orchis retains its simplicity, scarcely departing from the fixed rules; the middle petal is spotted and variegated more than the others, and there is a blunt spur or horn beneath.

In other plants of the orchis tribe, so curiously are parts altered and combined, that the flowers have a likeness to various insects. We have one on the chalk hills of Kent which exactly resembles a bee, and is commonly known as the bee orchis. Another is extremely like a fly; and the pale flowers of another are supposed to be like a spider. Then there is the man orchis, and the butterfly orchis, all on our chalk pastures. In the hot countries of the world this tribe exhibits many more extraordinary forms.

The butterfly plant of Trinidad has one flower at the end of a slender stem, sometimes as much as three feet in length, gracefully curved; the petals are long and curled, two of them very narrow and standing upright. The appearance of the whole flower is exactly that

of one of the strange insects of the West Indies.

There is one of these plants that is of a thick texture, and pure white; the three principal outer petals are expanded; of the three inner petals one is concave,—all seem to be forming a sheltering nest for a beautiful white dove seen within, the wings half spread open. The top of the column, with the anther, is the head of the bird, and the effect of the whole is most pleasing; but you must see this dove-flower of Panama to understand its beauty.

Doubtless there remains yet a concealed store of similar remarkable flowers to be discovered in the unexplored recesses of South American forests, or in the unknown districts of the wild interior of any of the vast continents. The treasures of the tropical tribes of flowers are at all times wonderful to behold, and excite our admiration; but the humble student must seek more lowly examples for study and examination. The native flowers of our fields, woods, and hedges, afford as much interest in the study of their nature as do the richest productions of the tropics. Perhaps, also, the small and deli-

cate flowers yield more striking proofs of wise arrangement and plan, than even the larger specimens. But all afford delight of the most rational kind. Those plants which contribute to our daily comfort, more especially to our food, are derived from many tribes and many countries.

We have already spoken of the roots, stems, and leaves, which supply us abundantly; we can now notice the flowers which are useful for some purposes, not many for food.

One of the few vegetables of which the flower itself is eatable, is the artichoke; of that, the soft ends of the numerous thick petals of the compound flower, and the fleshy portion on which the little florets of the centre stand, are the two p ars good for food. Cauliflowers and brocoli are the mass of flower-stalks and unopened flower-buds, all much enlarged and rendered succulent by artificial culture.

Some flowers are employed medicinally, as those of chamomile, intensely bitter. The petals of the rose have a delightful fragrance, which makes them valuable; and they are, moreover, prepared as a medicine. The flowers

of the elder-bush, very common in hedges and cottage gardens, are extremely sweet-scented, and are employed for several purposes.

The most highly fragrant flowers we do not expect to meet with in our temperate country; for it appears as if the richest properties of plants require greater heat of the sun, and a purer atmosphere, to develop them in perfection. As we advance southwards, in France, or still further, we find several plants having very deliciously scented flowers. The white jasmine bears a profusion of flowers throughout the summer months, and yields an abundant supply of perfume. The orange flowers also rank amongst the most valuable, for the sweet oil contained in the little glands, which are visible on their thick white petals, as well as on all other parts of the plant. In the south of France and Italy, also, the sweet-scented lavender grows very frequently, and is one of the most favourite of perfumes.

These are but a very small selection out of the extensive class of plants which have fragrant flowers; they abound in many countries, and afford much refreshment and delight, not

only in their natural state of freshness, but the art of extracting their scent has increased and prolonged the pleasure. I have said that the more fragrant flowers abound most in hot climates. This is one token of the wisdom that has arranged all things in their right place; for in the warmer countries the exhaustion of strength and vigour is far greater than we experience in our temperate region, and the refreshment afforded by perfumes is not a mere luxury. This is also one of the innumerable proofs that all things are in some sense made for man; and the consideration of this one subject will raise our grateful thoughts to the Creator, and cause us to say, "What is man, that thou art mindful of him?" For we cannot discover that the fragrant oil which flowers are enabled to prepare and store up in their countless small receptacles, is of any advantage to the growth and development of the plant itself. Man has, however, been gifted with sense to appreciate it, with knowledge to give him power to extract it for his use, and to adapt it to various purposes valuable for the restoration of health and strength. This one result of the

study of the nature of plants suffices to make us feel the truth of those words of the psalmist, "Thou makest him to have dominion over the works of thy hands."

And now, before we conclude this interesting subject, let us recall what we have learned during the short chapter on flowers. We have only been able to mention a very few examples from the immense list of plants now known and described; for they amount to more than ninety-three thousand, and the life of man would not enable any mind to comprehend them all. But if you have duly attended to the simple remarks made, and have found the entrance to this path of knowledge, you cannot fail to learn more as you proceed. Whenever any flower is within reach of your observation, examine it carefully; if it should not be of the regular form of any type you have already made acquaintance with, take notice of the way in which it differs. You will have no difficulty in future in recognising a buttercup, nor any example of the compound flower tribe, such as the daisy or dandelion. The common fruit-tree blossoms, also, you will understand; and you need be in no doubt

whether a certain tree, covered with white blossom in spring, be a pear or a plum, although in appearance the flowers are so nearly similar. You can easily ascertain if the future fruit, small as it will be at that time, be placed entirely above the petals, or below them. When the first primroses appear, in the beginning of the year, you will perceive at once that they belong to the great class of plants that spring out of the seed with two seed-leaves; for although those we see almost always proceed from old roots, not from seeds, yet there is a visible declaration of their position in the vast natural classification of plants. Do they not clearly proclaim their place? Their pale yellow flowers are parted into five petals; within the tube you perceive five stamens; and, moreover, their green leaves are covered with branching veins. But just now we are to consider only the flower. The next flowers that will follow in the floral year will be the snowdrop and the crocus, both of which evidently belong to the other class—that which has all the parts of the flower divided into three.

That portion of a flower which is an irregu-

larity from the usual laws of development, is the spur or horn, which I spoke of in the orchis tribe. In some flowers it is a nectary, or honey-cup, and contains a little store ready for the bees, who readily discover where their treasure lies. You may often observe these diligent creatures diving into the depths of a flower for the honey at the base; but in some flowers this would be difficult: then the bees attack it on the outside, and, flying rapidly from one flower to another, bite a small hole and extract the honey. Should you meet with a columbine flower in a garden, you will perceive that each of the five petals has a long spur hanging downwards.

Some flowers, as the rose, the anemone, the ranunculus, are easily rendered manifold by cultivation, having in their original simple state only five petals each. But there are a few which are naturally formed of several rows of petals. The white water-lily is the best example of this kind of flower in our country; and it is as capable of illustrating the plan as the splendid Victoria, measuring eighteen inches across the flower in the rivers of South

America. The outer part, the calyx, is in four parts only. The white petals are numerous, set in several rows around the base of the large central seed-vessel. We will now have no difficulty in recognising a flower belonging to the extensive four-petaled, cross-flowered tribe. Our native watercress, and several of the common garden vegetables, will explain that to us, if they are suffered to remain in the ground till the time of flowering.

There is still one large and useful tribe which deserves some notice, and that is the one from which we derive beans and peas for food, and many pleasant flowers for our gardens, especially the general favourite, sweet peas. The calyx is composed of five parts at the top, and the flower of five petals; but they are not all flat, as in other flowers. The upper petal is in general of a rounded shape, folded down the middle, but spread open; the two side-petals partly cover the two lower petals, which adhere together and form a kind of case or sheath, in which reposes the column rising from the seed-vessel, enclosed in the threads of the stamens, making a tube for it. There are

countless varieties of this form of flower; but there are rules which all obey more or less, and they are easily distinguished from all other kinds of flowers. The tribe contains many flowers of extreme beauty of form and colour, of which we cannot now consider. This one tribe would require a whole chapter; but I would wish to give you some idea of it. Then, when you see the elegant golden laburnum, or the delicate purple wisteria from China, or the acacia-tree of North America, with its clusters of white flowers, or you pass, in a country walk, through a field of sweet-scented beans, you may have occasion to examine the formation of this kind of flower; and, as in the case of the fruit-tree blossoms we mentioned, you will be able to ascertain what will be the future form of the seed-vessel—for there it will surely be, having already begun to prepare its store of wholesome nourishment in its seeds. The food yielded by the seeds of this tribe is called pulse, and has been celebrated for its nutritive properties in all ages. It was that which Daniel and his companions ate: "And at the end of ten days their countenances appeared

fairer and fatter in flesh than all the children which did eat the portion of the king's meat." Thus we find beauty and utility mercifully combined, and all things created contribute, each in their appointed place and manner to the service of man.

CHAPTER VII.

THE FRUIT.

We have now to consider the final result of all the previous work of a plant. We will study it in its complete state of having brought its fruit to perfection—to that ripeness which renders it suitable food for man, and also proves that the seeds are in a fit condition to be sown in the ground. On the sixth day of creation, "every tree, in the which is the fruit of a tree yielding seed," was given to man for meat. It is, as we know, therefore, the most natural and agreeable food; it is still the first simple nourishment of the natives of uncivilized countries; and, moreover, the most agreeable luxury in refined and civilized life. There is scarcely any country which does not possess some native fruits; but the great abundance will be found in the hot regions, and the inhabitants of the coldest countries in the north have only a very few small, tasteless berries, which are, however, extremely useful to them. In the present time, the fruits

of all lands are transported over the world wherever their nature will allow of so doing; and various kinds have become generally cultivated in the gardens of all temperate climates. But before we speak of the variety of fruits that are dispersed over the world, and their value to man, we must first examine what a fruit is in itself,—how it has been produced upon the tree, and what is its use and object.

We have watched the process of growth in a plant, from the seed upwards, and in this examination we discovered that there is continually a work going forward throughout the whole plant, and that leaves are active agents in carrying it on. In some large trees the great result obtained is hard solid wood, to be used as timber by man; the fruit is, comparatively, insignificant. In other instances, we perceive short-lived flowers in spring, but the seeds that follow are not good for food—are not required to be sown for fresh plants, and, therefore, both they and the blossoms pass away unnoticed in their appointed time.

But there is a large class of trees, shrubs, and herbs, the flowers of which prepare a goodly

store of fruits which ripen, and, in their season, yield a plentiful supply of refreshing nourishment to us. It is by no means general, that the seed of a plant should be enveloped, or in any way connected with what we call fruit, that is a sweet pulpy substance of pleasant flavour. This is one of the bountiful provisions made for man, for his use and comfort entirely.

In the chapter on flowers, it was remarked that certain portions of them are necessary to the formation of the future seed, or fruit; but the beautiful forms and colours of the petals appear, undoubtedly, to be made for the delight and gratification of man. So it is with fruits; a dry, tough skin, would be an effectual covering to the seed of all plants, just as the chaff is to the seed of corn; the sweet pleasant juices of the fruit do not nourish the seed, nor in any way contribute to the prosperity of the tree.

When we examined some specimens of flowers, you will remember there was always in the centre, securely placed, a small green, round or oval object, the future seed or fruit. You remember also, that in some flowers we found only just the top of this little green object, ap-

pearing above the hollow space in the middle of the flower. An apple is a fruit of this kind; and we should know this even, if we had never examined the blossom, because, at the top of the ripe fruit, there still remain the withered points of the calyx, although the petals have long since withered and vanished. And of what does an apple consist,—how shall we describe it? Cut it into two pieces; then you will see that it is a fleshy fruit, having five seeds, each in a separate cell, lined with a thin, firm skin; this is commonly called the core.

A pear is arranged on the same plan, and belongs to the same tribe of plants.

The quince, also; and the fruit of the hawthorn, only that it has not so large a portion of fleshy exterior; for this reason, it serves not for the food of man, but of birds.

Another class contains what we call stone fruits; that is, those which have only one seed within, and that having a hard shell, like the peach, apricot, and nectarine.

A third class we can examine in an orange; this fruit is placed above the flower, as well as the stony-seeded fruits. It is covered by a

spongy rind, which can be easily separated from the pulp when ripe; the pulp is composed of an enlarged cellular substance, filled with juice, in which the seeds are embedded; not fixed in dry, separate cells, as in apples and pears: the extremely succulent substance unites closely together, so that the cells can be readily parted after the rind is taken off.

The grape will explain to you a different kind of fruit; it has a thin outer covering, over a mass of soft juicy pulp, containing several seeds; as soon as the small, green flower, composed of five pointed petals, which cling together at their points, has fallen off whole, the fruit begins to enlarge; and, in due time, becomes changed, from a hard green case, holding the four or five seeds, into a ripe fruit. Everybody knows that the fruit of the vine is sweet and delicious, that it has a very peculiar and remarkable property of refreshment and strength, both in its orignal fresh state, and when dried as raisins; and, above all, when made into wine. How it acquires this valuable quality in its juice nobody knows; but we can trace something of the probable system of change of

nature,—from a hard, dry, small beginning, to a fully developed luscious fruit.

Chemists have searched into these mysteries of nature, and have discovered a clue to the marvellous work ever going on in plants, and more especially in the formation and ripening of fruit. As the growth of a fruit proceeds, it is continually parting with carbon, and thus becomes softer in its substance.

Another change is in the quality of the juice, which gradually loses its acidity and acquires sweetness. In this part of the work the help of the leaves seems to be essential; and gardeners are careful not to injure or take away those leaves which grow near the clusters of fruit. The action of air upon fruit is evident; and it has been ascertained, that even those fruits of which the inner part is eatable, such as walnuts and nuts, are affected by the outward air; the shell being, whilst in a tender state, sufficiently porous to admit the free passage of air through its cells. Fruits, in general, must remain on the tree until they are ripe, because the leaves are still working for their benefit,—adding new substances to the whole system, and

materially assisting the fruit in its process of ripening.

One more kind of fruit we will now examine is in some respects like the grape, but you will perceive in what part it differs. Currants are soft berries, covered with a thin skin, containing soft juicy pulp, in which lie the seeds. So far they resemble grapes; but, at the top of a currant, there remains the little withered calyx, showing that the flower has been attached to the fruit there, and not below it as in the grape.

Gooseberries are exactly on the same plan, varied only in size, roughness of outer skin and flavour, when ripe. The change that occurs between a ripe, and an unripe fruit, is remarkably obvious in a gooseberry; if cooked whilst green, they are so acid as to require a large quantity of sugar to render them eatable. If we wait till Nature has ripened them, do we find it still necessary to cook them or to add sugar to make them pleasant to the taste?—No; for instead of possessing the least possible portion of sugar in their pulp, they have acquired more than a sixth part of the whole contents in pure sweet sugar, very nearly resembling that of the

true sugar-cane. Gum, water, and a few other substances, have diminished; sugar has increased. This is the history of all fruit in its progress from green and hard, to ripe and soft; and as we have already observed, in all parts of the vegetable race, the plan is simple, uniform, and regular, but the manner of carrying it out is varied beyond description.

The acquisition of sugar in ripe fruit is still more striking in apricots; they are produced in such extreme abundance on the trees that it is generally necessary to gather a great number, as soon as they are half-formed in size, and not at all advanced towards maturity. The outer part is still green, tough, fibrous, and acid in flavour; so nearly destitute of every trace of sugar that, if cooked, they would require a very large proportion. If we partake of those which have remained on the tree, receiving the full influence of the summer sun to enable them to effect their ripening, they are of the most delicious sweetness and flavour, requiring no addition of sugar. The woody matter they contained has dissolved to the half of what it was at first; an acid juice has diminished in the same manner,

and other substances have undergone what we call a chemical change.

We will now examine another form of fruit, of which you have already seen an example under a varied aspect. You saw in the centre of a buttercup a small round heap of green seeds; these are hard and dry, and are so to the end. If we look into the flower of a strawberry, we perceive also a heap of small green seeds; but they do not continue so; as the fruit enlarges the substance on which they are placed becomes a soft pulp, swelling and filling with sweet juice, the seed remaining on the outside. At last the ripeness is completed, and the eatable part of the fruit separates from the soft inner piece on which it first grew. There is very nearly the same plan in raspberries and blackberries; only the numerous seeds are not fixed to the outside, but are concealed in the pulp. The inside receptacle to which the whole is attached at first is hard and dry; not soft, like that of the strawberry. Here we see three varieties of what are called aggregate fruit; many seeds in each, but a difference of arrangement. Those of the buttercup are dry seeds on

a dry central piece, having no pulp; those of the strawberry are dry, placed outside soft pulp, and the centre is also soft; the fruit of the raspberry has dry seeds inside the soft pulp, and the central piece is hard, remaining on the stalk when the fruit is gathered.

Let us now take a mulberry. At first sight it seems partly to resemble the blackberry, but on examining it we find it different. It is a cluster of seeds, each one contained within two or three rows of a very succulent calyx; all becomes a soft mass of pulp when ripe, excepting the tough central piece to which the clustered flowers were at first attached.

We may here observe what a power the fruit of a tree has to work out its own peculiar juices; for that of the mulberry-tree in general is an acrid white milk, as you may ascertain by breaking a leaf-stalk; that of a ripe mulberry is of the richest purple colour, and exceedingly luscious.

In the same great tribe of plants having a milky juice, there is another very remarkable and valuble fruit—the ancient and well-known fig. In speaking of flowers, it was remarked

that we watch for the appearance of blossoms on fruit-trees with especial interest, because they are to us a sure token of coming fruit for use and enjoyment. But the most attentive observer will never see flowers on the fig-tree. How, then, does it produce fruit? If you examine the branches in spring, you will discover at the bottom of each leaf-stalk a green fruit growing out of the branch; it comes forth in the same form and colour in the early part of the year, small and hard at first, gradually growing to its full size. It is composed of a tough, thick skin, enclosing within numerous small fleshy flowers, each having a little round seed at the bottom. The covering, you may perceive, is open at the top in five points, not altogether unlike the top of an apple, where the remains of the calyx are to be seen. When a fig is quite ripe, every part, both flowers and outer skin, become soft and filled with sugar; then you can easily pick out one of the tiny flowers and examine it. It is something like one of the central yellow florets of the daisy—a slender vase-like shape, parted at the top into five narrow petals. A solitary round seed, with a brittle shell, is at the end of

the tube below. The power of converting disagreeable acrid juices into delicious saccharine pulp, is displayed in the fig in a striking degree. The juice of the branches is highly pungent; but when the process of ripening is complete in the fruit, an extraordinary quantity of sugar is secreted. This often drains out at the end of the fruit, and is called the "tear of the fig;" it may be frequently found in dried figs, a clear candied drop of sugar. This abundant supply of sugar enables the fruit to dry in the sun, the same as grapes and plums, in the warm countries of the South. They afford much wholesome nourishment; and in Italy, where the trees abound in every garden, figs are the common daily food of the people; a piece of bread and a few figs fresh from the tree, form the general morning meal.

There is a peculiar interest belonging to figs. We read of them very often in the Old, as well as the New Testament. It was a sign of the peace and happiness of the reign of Solomon, that every man dwelt safely under his fig-tree. A fig-tree was made a warning to the unrepenting Jews: "Behold, these three years I come

seeking fruit, and find none: cut it down; why cumbereth it the ground?" It is still a common tree in Judea, and in all the countries of the East, affording a refreshing shade with its large dark leaves.

In this instance we observe very plainly that the leaf is intended to be of use to the fruit, for they are placed close together; and if any one should fear that the thick leaves shade the sun too much from the fruit, and be induced to take them off, let them be reminded that leaves are helping the fruit, not impeding it; for all the juices must pass through them, and be thus aided in their conversion into sugar. Figs are not only extremely nourishing, but have also healing properties. The first mention in any history of a healing plaster being used, is when Isaiah advised King Hezekiah to "take a lump of figs" as a cure; this happened two thousand five hundred and seventy years ago. Their nature has not yet changed, and they are still used in some countries for the same purpose.

There is another fruit of the warm climates that is almost always associated with the fig; that is, the olive. It is about the size and shape

of a damson, soft on the outside, and having a hard-shelled seed within. The pulpy part never attains the pleasant sweetness of other fruits, but has a bitter flavour even when ripe. They are generally soaked in salt and water before they are eaten, to soften; but few persons can relish olives except Italians and Spaniards, who are early used to them. The value of the olive fruit is in the oil contained in the outer part; this is extremely pure, and of agreeable flavour; it is commonly used in cooking various kinds of food in Southern Europe, and is of a very wholesome nature. The purest oil drops from the ripe fruit with slight pressure; but all is employed for different purposes. You have learned in a former chapter that seeds yield oil; this is very general amongst some tribes of plants; but the olive is the only known instance of a fruit containing oil in the soft outer covering to the seed. The olive has been esteemed in every period of the world; in the earliest times it was so highly valued that it became a very significant emblem of the greatest prosperity and peace; "a land of oil-olive" was one of the signs of the good land given to the Israelites; and the

oil of the olive fruit was used for the holiest purposes.

There is another form of fruit, of which we will now speak, called the melon. Various kinds of gourds belong to the same tribe, and are arranged after the same plan. These have all a tough outer skin, covering a thick layer of soft pulp, generally sweet and juicy, more or less so, according to the variety. This is the eatable portion; within is a hollow space, to the sides of which the numerous flat seeds are fixed; the cavity, when the fruit is quite ripe, becomes full of an extremely juicy pulp. Melons are valuable food in the hot countries in the south of Europe, the abundance of cooling pulp being extremely acceptable to the inhabitants. Gourds are more solid in substance, and are cooked before they are fit to be eaten. In Sussex and some other counties in the south of England, gourds grow very well, though not to the enormous size they are to be seen in Germany or France. They are, however, useful to the farmers and cottagers, and the young boys who go out to watch sheep on the downs, or to spend a whole day in field-labour, are provided by their mothers with a pie

made of slices of gourd, which is a satisfying meal. In France, where they sometimes measure three or four feet around the outside, it is customary to buy a portion only in the markets, a few slices to be made into soup, or to prepare in some way with other materials. The growth of these fruits is rapid; the plants are all herbs, that is, they arise from seeds sown in spring; the yellow flowers come forth in the beginning of summer, and during the hot weeks that follow, melons and gourds soon come to their full size and ripeness. I have said that they grow better in the south of Europe, that is because the sun shines hotter there than here. The more delicate fruit of the melon would not thrive at all here, unless it were sheltered under glass, as is usual in all gardens.

In some future chapter I hope to say something more about the different climates that various plants require, then you will understand many things about fruit; why we can have some kinds abundantly, whilst others are rare, and cost much to buy. This reminds me of a fruit which formerly was so expensive in England, that few but the richest persons could afford to

have it in their gardens, or to purchase it. The pine-apple is considered one of the choicest of fruits, of extremely delicate substance and fine flavour. About two hundred and thirty years ago, pine-apples were first brought to Europe from South America; and, in the course of a short time, were conveyed to this country, where those who could afford well-heated conservatories began to cultivate them. It is only during the last few years of our speedy intercourse with the West Indies by steamships, that pine-apples have been brought from thence in such large quantities, during a few weeks of summer, that they can be bought for a small sum; instead of one guinea each, the price is now a shilling. This is a curious fact, and brings many considerations with it to our minds—especially that of the great advantage of mutual exchange of the productions of the different regions of the world. We have observed this before in the first chapter; how much benefit is derived to us and to the West Indians, and, indeed, to all the inhabitants of the earth, in some degree, by our trade with them in cotton.

But we must not leave the pine-apple yet.

Although almost everybody in London or Liverpool, or other seaports, whence ships depart for, and return from the West Indies, may now know a pine-apple by sight, and many also know it in its delightful flavour, there may be only a few who have had opportunity to examine and learn its structure. That is what we wish to teach now; what is desired as food is sure to be sought for and attended to for that purpose. Will there not be some satisfaction in learning how the fruit is composed, and thus increase the pleasure we feel at the plentiful supply now brought for our use? The fruit of a pine-apple is quite unlike any other we have as yet studied. Let us observe how it is in the beginning.

In its early growth there is a circle of long, narrow, stiff leaves, from the midst of which rises a stem, with clusters of small flowers set thickly around it. We perceive directly it belongs to the palm, or lily class; that is, to the large division of plants having single stems, straight leaves, and the flowers parted into three or six pieces. If you look into the flower you will see that there are three parts to the calyx, and three petals surrounding the six stamens.

The future seed is below all this; and surrounding each flower are small leafy scales. Instead of the flowers withering and falling away, as is the case with many fruit plants, they remain in their place, and become softer in substance, fleshy, pulpy, and juicy. In due time the whole mass of flowers on the stem is changed into one ripe fruit; the seeds cannot be extracted; all is blended together and fit for food, excepting just the outer part, which has hardened into a kind of rind. The seeds being thus consumed with the rest of the fruit, the method of continuing the race of plants is by planting the crown of short stiff leaves, which proceeds always from the top of the stem above the fruit.

There are two kinds of pleasant acid juice existing in fruits; one is that of apples, the other that of oranges and lemons. The combination of these two juices together in the pine-apple is the reason of its peculiarly exquisite flavour. A large proportion of sugar blends with these, and renders the fruit, in its ripe state, not only delicious, but wholesome, which it would not otherwise be; for the nature of the acid juices, whilst unripe, is extremely powerful:

even when ripe, it corrodes a steel knife used in cutting it into slices.

Now, let us consider another most valuable fruit, not only serving as an agreeable refreshment, but actually forming the chief nourishment of a very large population in the tropical countries of the world, that is wherever the sun is so high in the heavens as to shine down with great power on the earth. In these parts, whether in the East Indies, or in the West Indies and South America, the natives live almost entirely on the fruit of the banana. The trees resemble palms in their manner of growth, having a straight, single, unbranched stem, bearing a crown of large leaves on the summit. In the midst of this crown there springs out a strong flower-stalk; it is covered with rows of dark-brown sheaths—one of which, at the bottom of the stalk, lifts up, and then a few, slender, pale flowers are seen. These perform their allotted work, prepare the young fruit, then fall away, and the fruit enlarges, turns backwards and ripens,—becoming, instead of green, a dull yellow. The substance softens, and is of a pleasant taste—not usually liked by

Europeans at first, but much relished by the natives. The fruit is somewhat triangular, about the size and length of a small cucumber, eight or nine inches long; the seeds are placed in a double row, in three cells, down the whole length of the fruit. It contains an unusual portion of farinaceous nutritive substance, four-fold that of the potato, and one hundred and thirty-three times as much as wheat. It has, when ripe, acquired so much saccharine juice, that it dries in the sun like figs, and may thus be kept for many years. Boiled, or roasted, it is eaten like bread; when perfectly ripe, it may be preserved as a sweetmeat; and a kind of wine is sometimes prepared from it. In the conservatories of this country the fruit now is brought to a certain degree of ripeness, but it is far from having the full portion of sugar or nourishing properties. Not only is the fruit extremely precious to the inhabitants of the tropics, but of every part of the tree they make something useful. The large leaves thatch the huts; the fibres of the stalk are formed into baskets, cordage, mats, and many other useful articles. From the base of the stem there

shoot up as many as ten or twelve young plants, which keep up a continual succession in the supply of food throughout the year. Near to every dwelling there is a plantation of bananas; and the owner is careful to plant another tree whenever one fails, or his want of food increases, for he needs no other variety. The Europeans who settle in the hot countries use it also, as a kind of bread to eat with their salt meat or fish.

There is another remarkable fruit which rivals the banana in value—feeding the larger portion of the inhabitants of the islands scattered over the South Pacific Ocean; it is called the bread-fruit, and was found to be so valuable to the islanders by an English captain, of the name of Bligh, that he was, on his return to England, sent out again by our government to convey some plants to the West Indies, where it might afford cheap and wholesome food to the negro slaves. It was during this voyage that the extraordinary mutiny of the ship's crew occurred under the man named Christian. This delayed the transplantation of the bread-fruit; but it was afterwards successfully accomplished by Captain

Bligh, and has flourished in the West Indies ever since. Upwards of one thousand two hundred young bread-fruit trees were taken from Tahiti, and planted in the different islands which compose our West Indian colonies, and from thence they have spread over different parts of South America. This fruit is very unlike any other we have yet spoken of; it is of a round shape, as large as a child's head, covered on the outside with seeds set in fleshy calyxes; in some kinds the seeds do not come to perfection, then the whole mass is eatable; being a wholesome substance, like the crumb of white bread in appearance, and containing a large proportion of starch. It is not eaten in a raw state, but is usually cooked in the oil of a palm, or roasted; the taste is insipid, but is thought to resemble that of bread.

One variety is called Jaca fruit,—weighing, sometimes, thirty pounds; but it is of inferior value as nourishing food. The seeds are generally taken out and roasted separately. During the greater part of the year the bread-fruit is to be obtained—consequently, it has proved a valuable addition to the common food of

the West Indies, both for natives and Europeans.

Whilst we are speaking of the fruits of the tropics, we must not omit to mention the custard-apple, which is much esteemed in the West Indies; it is about the size of a large apple, but not smooth outside, for the seeds are in cells, which project, and cause the whole surface to be covered with their oval swellings. The succulent mass of the interior is said to be like custard, which gave the name to the fruit. Natives think it delicious, but Europeans seldom like it, until a long residence in a tropical country enables them to acquire the taste for it.

One variety, called the sour-sop, in Jamaica, has the flavour of our black currants.

Another kind, in Peru, the cherimoyer, is considered by some persons to be one of the most delicious of fruits.

In the East Indies there are many fruits unknown to us here, in a fresh state. The mango is frequently sent over pickled in vinegar, whilst still hard and green; but, in its native country, it is eaten when ripe, and is highly valued. The trees are remarkable for their noble growth

and rich foliage on slender branches; the mango groves in the neighbourhood of Lahore are fine specimens of Indian vegetation. Although the flower of the mango is entirely different from that of the peach or plum, yet it has the same arrangement in the fruit—soft, juicy pulp outside, and a hard-shelled seed within; both of a kidney-shape peculiar to the mango.

In the same tribe of plants we find the cashew-nut—a singular fruit, having the seed in a hard shell of a heart-shape, uncovered by pulp or any kind of substance. What appears to be the fruit below the seed, is the enlarged top of the stalk, which becomes pulpy; of a red colour, when ripe, and has an agreeable acid flavour; eatable, either fresh or roasted. A pleasant kind of wine is sometimes prepared from this strange fruit. Between the shell and the kernel there is a thick caustic oil, which blisters the skin of the fingers if incautiously touched; the natives use this for preserving wood from decay. The fresh kernels are of delicious flavour when young; in an older state they are generally roasted, and, if mixed with cocoa, make an excellent chocolate.

There are numerous other fruits in the hot countries of South America, as well as in Asia; in the islands of the Indian Ocean there are several of considerable value to the native inhabitants, though neither known nor valued as food by Europeans, except a very few who may chance to reside in those distant regions of the world. Some it would be impossible to describe to you; others you would not be sufficiently interested to hear about; but those of which you can see examples in the shops, and know that they are good for food, it would be well to learn something about.

One only of a large tribe of plants yielding eatable fruit in various tropical countries is likely to be known to you; that is the litchi, now very commonly brought in ships from China. It is about the size of a walnut, but quite round; the outer shell is thin and brittle, covered with small pointed projections. Within is the soft, pulpy part of the fruit, covering the hard seed; the flavour of the pulp is extremely agreeable on eating it, but afterwards it causes a peculiar sharp acrid taste in the mouth, which is remarked in several other tropical fruits. The outer shell,

excluding the air, preserves these litchi fruits during a long time; and they may be bought in the shops of large towns now, at almost any season of the year. Until late years, they were only occasionally sent as presents from merchants in China to friends in England.

Before we leave the fruits of the tropics, let us examine another preserved fruit, generally known as a pleasant refreshment, as well as used medicinally. Tamarinds are only to be seen here in a bruised condition, having been boiled; you cannot, therefore, discover what was their original shape and arrangement. We have studied several different forms of fruit in this chapter; now we have to describe the tamarind, we must search in another tribe, one of which we examined in the chapter on flowers. It is that tribe which has what are called pods for the seed-vessels. Peas and beans belong to it. They are sometimes eaten whole, seeds and seed-vessels cooked together, as French beans. What we call broad beans have a very tough skin for the pod, and we eat only the soft seeds, before they are ripe and hard. In this instance of tamarinds, there is the same long seed-vessel, containing

many seeds, very hard when ripe, and at no period fit to eat either fresh or cooked. The portion of the fruit that is palatable is the pulp, which fills the pod or seed-vessel; the outer part is brittle, containing strong fibres, which we see remaining in the pulp. Each seed is covered with a tough leathery kind of skin; the seed itself is hard, and of a dark brown colour on the outside, white within; when ingeniously cut, patterns may be made on it by leaving some parts with the dark skin on. Boiling, in preserving, does not injure them; for, if you sow these seeds, and cover them with glass, they will grow and produce beautiful little plants, with the very elegant leaves, as many as fourteen small leaflets on one stalk. But what gives the preserved pulp the cooling, refreshing qualities, that are so suitable for the sick, as well as agreeable to the healthy? It is the combination of three kinds of acid juice in the tamarind that gives it peculiar flavour and value; the tartaric acid is there, as well as that which exists likewise in the apple, and that which is in the orange. Every one who has tasted tamarinds, must have perceived that they are remarkably acid, espe-

cially those which come from the East Indies, and are chiefly used medicinally. The West Indian tamarinds are preserved with a considerable quantity of sugar, and are therefore more agreeable to the taste. Why the fruit has such extreme acidity we should not have known, had not chemists examined it carefully, and discovered its composition chemically. Other observers can find out the different visible substances; we can all see the dark pulp, and the strong fibres mixed with it, and the smooth polished seeds, like stones; and we can each perceive, if we taste it, that it has an extremely acid flavour, unlike that of any other fruit we ever ate. We cannot all make scientific researches for ourselves; but we can learn the results of the studies of wise men, and accept gratefully what knowledge and wisdom they unfold to us out of the hidden treasures of vegetation. And by thus tracing out the real properties of natural objects, such as fruits, how much benefit is derived to mankind! We cease to think of fruit as sweet, pleasant refreshment only, when we learn that, by ascertaining the different qualities of the ripe pulp, it can be applied to the relief of pain

and suffering. Instead of merely pleasing our taste by eating pulpy tamarinds, we can prepare a cooling beverage from them, to relieve the burning thirst of fever, to refresh the faint and weak.

We all know what oranges are, and enjoy their sweet, juicy pulp; they are pleasant to most persons in health and strength, and are one of the merciful means given abundantly to preserve them in health. There is one kind of fruit in the same tribe, that has long been known to the inhabitants of Malabar and Ceylon as a very valuable medicine in a particular form of illness. English physicians now employ it also successfully, and it is sent to England nicely preserved, ready for use.

We have now spoken of fruits belonging to various countries, and chiefly of those which are natives of warmer climates than that of England. We must not forget those which grow naturally in our own islands. There are several worthy of notice; let us observe their names and character. In the northern counties of England, and in the Highlands of Scotland, there are wide districts of moors and heaths; on these wild parts grow cranberries, bilberries, wortleberries, and

cowberries. They all belong to the same tribe, and have nearly the same properties and flavour; they are cooked whilst fresh in various ways, and are commonly made into jelly, and form part of every meal in the remote habitations of the north. On the top of the ripe fruit there are the four withered points of the calyx; within the soft pulp we find four or five cells, filled with many small seeds. It is evident that the red fruit of the cranberry possesses acid juices, for in Sweden it is employed to clean silver from the small particles of copper alloy. The raspberries cultivated in gardens have been improved and enlarged by care; and some of the best sorts were brought from Holland. In the woods of Yorkshire raspberries grow plentifully; and, though the fruit is small, the flavour is excellent. Dewberries also are found occasionally in bushy places; the fruit is black and juicy, very agreeably acid. The cloudberry is a native of the lofty mountains in the north of Britain, and in Wales; it is of a dull red-brown, and has an acid taste resembling that of tamarinds. But the best known of all this tribe is the blackberry; it is of a hardy nature, and forms the hedges of

fields in almost all parts of England. The fruit is plentiful, and never fails to ripen in the month of September, affording to many poor children the only kind of fruit they can partake of.

We have already mentioned the elder-bush as yielding a useful kind of pith in its stems, and from its sweet-scented flowers an agreeable perfume. The fruit is small, on branching clustered stalks, of a dark purple, almost black colour, containing three seeds in one cell within. A wholesome kind of wine is made of the berries by those who live in solitary farms and cottages, and depend very much on the produce of their immediate neighbourhood.

We have not yet spoken of all the fruits we enjoy, either native in our land or cultivated. But you now know enough to enable you to think and observe for yourselves; and, before we leave this subject of fruits, there are a few observations to be made. It is first to be noticed, that all fruit-trees do not bear good fruit naturally—not sufficiently sweet, soft, and juicy, to please the taste of man, nor yet to afford wholesome nourishment. The present fine condition

and great variety of apples has been brought about by care and cultivation; the original stock was the wild apple-tree, or crab-tree, as it is sometimes called, of our woods and hedges. This crab-apple is small in size, very acid, and astringent; but, as we know, when the substance is enlarged and the proportion of sugar increased, as in the various garden apples, it becomes the wholesome, valuable fruit so much esteemed, and generally used almost throughout the year.

Many rich flavoured plums have also been obtained by culture from the common sloe of our hedges—a fruit so hard, sour, and acid, that it is absolutely uneatable until it has been shrivelled by the frosts of autumn. Of the system of grafting pieces of good fruit-trees on wild stocks we will speak more hereafter; but I think you will perceive that we may learn something for our instruction in this fact of the difference between a state of uncared-for nature, and the work that cultivation effects. This cannot fail to remind young persons of the vast difference between an uncultivated mind, and one strengthened, enlarged, and softened by instruction. We may well say strengthened; for look

at an apple or a pear-tree, bearing a full crop of fruit in autumn, what a weight can the branches support; one basket of ripe apples would be a burden to carry; but the tree bears the whole at once; though the boughs droop to the very ground, laden with rich juicy fruit, they do not break.

We have seen a few things in our examination of plants which are worth remembering, and especially as to their manner of producing leaves, flowers, and fruit. They can and do produce leaves, even under difficult or unfavourable circumstances; in London and other large cities, where the air is more or less filled with coal-smoke, some trees and shrubs will grow, and have a yearly crop of green leaves sprouting out of their blackened branches. Elms, planes, and limes all flourish in cities, and bear a full store of leaves; the flowers also come forth in spring as usual, but they are of the green leafy kind, not having the beautifully coloured petals of other flowers. Lilacs also grow in the gardens of cities; in the crowded parts they bear leaves, but the clusters of purple flowers appear in scanty quantity and size, and have not that

delightful fragance or brightness of colour which we find in those which grow in the pure air and light of the country. Almond-trees are very commonly planted in gardens close to cities; they fail not to blossom, but the flowers fade away, and they bring no fruit to perfection.

Since then we perceive that the fruit is the result of the perfect and complete development of a plant—that it is only produced when the plant itself is in a healthy and vigorous condition, and also when surrounding circumstances are favourable—we shall not be surprised at the idea of considering fruits as emblematic of our actions. Indeed, there can be no manner of doubt that it is a just one; for in the book of unerring wisdom they are frequently so employed. The meaning of the parable of the sower was explained to be in regard to the good seed sown on good ground; such as hear the word and receive it, and bring forth fruit; some thirty-fold, and some sixty-fold, some an hundred-fold. And again, when our Saviour, perceiving how hard it was for his disciples to comprehend his teaching, so different from any they had heard before, endeavoured to make their union with him more

obvious to them, took up the similitude of the vine and its fruit, saying, "He that abideth in me and I in him, the same bringeth forth much fruit." What that fruit meant is plain, from what he had spoken before, and what follows after,—nothing less than fulfilling his commandments. Then, also, there came a warning, "Bring forth fruit with patience,"—not expecting good thoughts, or good words, to produce good actions, speedily or without patient watching and tending, no more than we hope to see grapes on a vine the first year of its growth. Neither will any fruit tree, of a certainty, yield good fruit, unless all things are favourable. It may be overgrown with other plants, choked in its progress, and so bring no fruit to perfection. But, as a tree planted in good soil, free to receive the sun's rays and the dew and rain from heaven, will not fail to bring forth a plentiful harvest of fruit—so, likewise, will the "honest and good heart" be filled with that "wisdom which is from above, full of good fruits." When we look over the various countries of the world, and consider what numerous fruits are ordained to spring forth yearly, it occurs to us what a

wonderful proof they afford of the wisdom that ordereth all things. Each tree continuing to produce exactly the same sort of fruit; no change in their kind, only in the quality of some by cultivation. "By their fruits ye shall know them." "Do men gather grapes of thorns, or figs of thistles?" The deep meaning of the comparison of fruits with works is full of suggestion to our minds—it seems to convey so clearly an idea of what our actions should be. We value good fruit, not only because it is pleasant and good for food, but, also, because it contains what is the source of good to future generations yet unborn. The seed scattered out of the ripe fruit may spring up hereafter, and bear fruit in its due season. So it is with many deeds done in this world; they may lie hidden for a time, but they have sown their seed, and when "the early and the latter rain" shall have fallen upon it, they who have waited in patience for it will receive "the precious fruit."

CHAPTER VIII.

PALMS.

In the beginning of creation, when the trees and herbs were made on the third day, they were all pronounced by God, the creator, to be good. They were good, then, nearly six thousand years ago, and so they continue to this day. "The tree yielding fruit," was made perfect then, in the beginning of time; and so it is now—good in itself, each one after its kind, and good for man, the chief being of creation, for whose use all things were intended. We may examine any one of God's works, in any part of this world of his, and we shall find reason to admire and to praise its excellence. The commonest tuft of grass, the simplest herb, is full of beauty, and tells of the power of its Almighty Creator. We may well say, in the words of David, "O Lord, how manifold are thy works, in wisdom hast thou made them all." Or, we may sing with joyful hearts the ancient hymn, "O all ye green things of the

earth, bless ye the Lord, praise him and magnify him together." But there are some things in the vegetable race which appear to be more particularly marked out as objects worthy of our attention and admiration, and to set forth, in a striking manner, the wisdom and skill of Him who made them.

Among the various trees which adorn the surface of this earth, one kind has been usually esteemed the most noble in appearance, and valuable for its uses to the natives of the countries where it grows. The palm-trees were said by the famous Swedish naturalist, Linnæus, who wrote about all the trees and plants he could find, to be "the princes of the vegetable kingdom." Very noble and graceful is the palm; it has a peculiar manner of growth, unlike that of any other trees. You remember we spoke before of the two great classes of plants,—the one having branching stems, and branching veins in the leaves; the other, growing upwards with a single stem, and the leaves having long straight veins. Palms belong to this last class, and form the chief type and portion of it; they begin from the ground

with a round stem, which rises like a column, erect, without any branches, bearing a crown of leaves on the top. Each year a new bud of leaves springs forth in the centre, the form of the whole remaining the same. The clusters of flowers, also, come forth every spring-time, at the top of the stem, in great profusion; and all those kinds which have eatable fruit yield an abundant store to the people of tropical countries. We, also, in this distant land, in the temperate regions of the earth, where the climate is too cool for palms to grow in the open air, derive some benefit from their fruit. We all know what a cocoa-nut is, and dates, they both belong to palms; we will describe them presently. First, let us observe the countries where the air is hot enough for palms to flourish; they are found plentifully in a wide belt of the earth, between thirty-five degrees of latitude on the south of the equator, and forty on the north, that is, around the world where the rays of the sun shine most directly on the earth, and cause the greatest heat. Now, what countries do we find on the map lying on this wide band of the globe? In the eastern

hemisphere, or what is called the old world, because it was first inhabited and known, there is the whole of Africa, very nearly all that we call the East Indies, forming a large portion of Asia; and there is, likewise, almost the whole of Australia. In the western half of the globe we perceive that a very large portion of South America, all the West Indian islands, and also the southern provinces of North America; and, moreover, that vast multitude of isles, scattered over the Pacific Ocean, are all within the range of the great belt of the globe where palms can flourish. We shall not, therefore, be surprised to learn that already more than one thousand different kinds of palms are known and described, and, probably, many others are yet to be discovered in the unexplored forests of South America. The true region of palms extends only into the south of Spain and Italy; but there is one dwarf palm which advances into the south part of France, beyond the usual limit of the trees. This example of the whole tribe will afford as good a subject of illustration as any other, and is more readily seen in a growing state. In the south of Europe it

thrives in the open air; but in England it requires the shelter of a conservatory; in that of the Regent's Park, London, there is a dwarf palm, which for many years has not failed to produce the clusters of pale, yellow, green flowers, from the top of the stem, in the midst of the large fan-shaped leaves. The upper part of the stem is beset with the rough fibrous remains of the sheathing leaf-stalks; lower down it is smoother, marked only by the rings where the leaves of former years grew. You know already the arrangement of parts in the palm tribe; there is a regular law followed throughout in the adoption of the number three, but the variety of outward appearance is extreme. If we separate one of the clustered stalks of the flowers, we shall perceive the whole form and plan. First, there is a wide kind of sheath folded, out of which comes the flower-stalk, divided into branches thickly covered with the flowers. They have three points to the calyx, and three petals; then we find six stamens attached together at the base, bearing the pollen cases at the ends. The future seed vessel is composed of three cells,

Palm of the Forest.

Palm of the Forest

each containing a seed. In all palms the same plan will be found in the flower, though the fruit varies extremely—some having a soft, pulpy exterior, some a hard polished shell, others a thick fibrous external covering. The fruit of the dwarf palm is not eatable, as that of many others is. The leaves are plaited at the end of the stalk, and spread out into a fan-shape. If you once see and examine a palm, even if it be only one of these most simple specimens, you will always be able to recognise them, for they have certain very striking characteristics.

In speaking of the stem, in the fourth chapter we described that portion of a palm; we found no solid wood that can be used as timber, —nothing but a mass of pithy substance, and fibrous vessels, firmly held and bound together by strong fibres which cover the outside, and pass in a sloping direction into the interior. These fibres, as well as those of the strong netted sheaths which wrap the leaf-stalks and bind them to the stem, are of the greatest use to the native inhabitants of the palm countries, and, of late years, have been found to be

extremely useful to us also. They are now employed for making cables for the largest ships, and for every kind of rope and cordage. During the last ten years this fibrous material has been found so serviceable in England, that no British ship leaves the coast of Brazil, or any port on the west of Africa, without bringing away a good store of bundles of dark-brown palm fibres. All kinds of brooms and brushes are now made of them; the strong brooms used for sweeping the streets of London, and other large towns, are made entirely of palm fibres; we scarcely ever see an old-fashioned birch broom, or horse-hair broom now. In large halls, rooms, and passages, the strong, clean, cocoa-nut matting is in general use, and is considered the best of coverings for all kinds of floors. For the stuffing of mattresses palm fibres are excellent, being quite as elastic as horse-hair, though perhaps not so durable.

You thus perceive that, although the stem of palms is not useful as wood, it affords a very large portion of useful material for the service of man, both in his uncivilized rude state, and

in the civilized life he leads in cities. In his simple manner of living in the woods of South America, or elsewhere in the regions of palms, there is no necessity for a substantial house for a dwelling-place. The Indian who wishes for a home for his wife and children, need not wait long, or go far to seek a lodging. He chooses a favourable spot, near the woods for hunting, and near a stream for fishing; he soon clears a piece of ground, cuts down a few small palms, they suit his purpose better than the hard-wooded timber trees with their branching stems. Of these slender, yet tough palms he forms an outer wall, setting them upright in the ground, interlacing fibres of the older palms between them; he makes the framework of the roof of the same materials; then, having selected a large-leaved kind, he takes two or three leaves, which suffice to thatch it neatly, and protect him and his family from the scorching heat of the sun. The dwelling is soon finished and ready: his wife begins to furnish it; she gathers fibres from the palms, and weaves a mat to spread on the floor; she makes a strong basket to hold any-

thing she may have to keep in their humble abode, or to bring home the produce of the fishing and hunting. Out of the large tough sheaths which enclose the leaf-stalks, she readily forms a neat light cradle, which can be hung up in a safe place, and keep the little child secure from danger by wild animals, or any other hurtful thing. She selects a bit of the firmest black fibre, and uses it as a needle with which to sew together garments made of the softer fibres.

We have now discovered that two of the chief uses of all trees are supplied by palms—materials for dwellings, and for clothing; the third, and most important use of all, is for food. This also is afforded by palms most abundantly; in the different kinds, we find various articles of nourishment; some can only be partaken of in their native country, others can be preserved and brought here for our use. You may be surprised to hear how much is obtained from palms and their fruits—wine, oil, sugar, salt, sago, and the juicy pulp of the fruit also in its fresh state. Palm wine is called toddy; it is pressed from the thick large leaf that wraps

the mass of countless flower-buds. The best trees yield as much as a hundred pints of toddy in twenty-four hours; it seems to be produced in an inaccessible place, at the top of the column-like stem; but Indian boys are very active, and climb up with much ease, cut the bud, and, leaving a vessel to catch the precious juice, return again to fetch it. This rich liquid is also fermented, and by distillation, yields a kind of spirit, called arrack in the East Indies, and much esteemed. Sugar is obtained from the flowers; and, throughout the islands of the Indian Ocean, serves the natives as well as that of the sugar-cane.

One of the principal regions of palms is the valley of the Amazon, the largest river in the world, flowing into the Atlantic Ocean on the north-east coast of South America. There, within ten degrees of latitude on either side of the equator, is the favoured district of palms; their beautiful and graceful forms are the most striking objects to a traveller. To the wild untaught people of this uncultivated region of the earth, the products of palms are necessary to their very existence. One palm, called assai,

is tall and slender, sometimes eighty feet high, and not more than four inches in diameter; very beautiful it is, with its pale smooth stem gracefully curved, as if bent by the weight of its crown of bright green leaves. But not only is it to be admired for its beauty of form; it yields a very refreshing beverage from its fruit. A little below the crown of leaves there comes forth three or four sheaths, each containing a cluster of small whitish blossoms; the fruit that follows is about the size and colour of our sloe. Its hard seed has a fibrous coat, but over that is a thin covering of a fleshy pulp. From the ripe fruit Indian women prepare a delicious creamy liquid, of a fine purple colour, which is enjoyed by all who become acquainted with it. This palm grows plentifully in the town and neighbourhood of Para, the seaport at the north of one of the branches of the Amazon river; and young Indian girls carry about the assai wine in earthen jars to sell in the streets, just as commonly as milk is sold in England. When mixed with water, it is an exceedingly cool and agreeable drink, well suited to that hot climate.

There is another palm of this part of South America which grows to the height of a hundred feet, with a noble crest of leaves; the leaf-stalk at the base measures a foot in width, and is ten or twelve feet long; the fan-shaped leaf itself is ten feet wide, and would be as much as a man could carry. The fruit is the size of a small apple, and has a covering of pulp over the scaly seed; these are combined in so large a cluster, that whilst in the sheath two men would find it a heavy burden.

Does not this give a striking idea of the vast difference between palms, and any other species of tree, as well as the peculiar arrangement of such trees, so unlike that of all those of the other class with branching stems? What a grand scene they afford, covering wide tracts of land flooded by the overflow of the Amazon, no other tree or shrub breaking the regularity of the lofty columns of the stems, rising to the height of eighty or a hundred feet. For many miles they all appear to be of the same age, and of uniform growth. They are not only valuable for their fruit, from which the natives prepare a very agreeable slightly acid beverage, but the

fibres of leaf-stalks, leaves, and stems, are converted into various useful articles. Cordage for the boats in daily use on the rivers, and a string of which hammocks are made, the general sleeping-place of the native Indians, more or less ornamented, according to the taste and imagination of the different tribes. Some dye the cords of various bright colours, and make the network in gay patterns; for, in the lowest stage of civilization, there soon comes a desire for bright colouring or variety of pattern. In the manner of life led by these children of nature, far from all the resources of civilized life and homes, their wants are of a very different class from ours; and how beautifully palms are adapted to satisfy their wants we cannot fully know, though travellers have discovered many things of late years. The Indians of Brazil, in South America, have a singular weapon, with which they shoot birds and animals for food; not a bow and arrow, but a kind of blow-pipe, from which they blow out arrows with wonderful force and skill. In the Amazon country there is a palm that has the stem clothed with strong black spines of leaf-stalks;

of these the Indians make arrows, dipping the point in the poisonous juice of a plant of the country.

In speaking of the productions of tropical regions, in former chapters, we always found that if any were valuable to the natives, they had some properties that render them also useful to us, and worth being transported to our country; indeed, there are some of the natural objects of the wild lands that can only be brought to their complete value by the manufacture of educated persons. So it is with palms, valuable as they are, and indispensable to the poor Indians, yet they are very limited in their powers of bringing every part to its full use. There is one palm not at all remarkable for its graceful form, as many are, for the short stem is thickly covered with hairy fibres, of the same nature as all palm fibres, but far more abundant, and rougher at the edges. The Brazilians knew the value of these fibres long ago, and the first canoes which floated on the gigantic rivers of that country were provided with ropes made of this palm fibre. It was not till the nineteenth century that Englishmen, who use more ropes

and cables than any other nation in the world, found out what a precious material this rough, uncouth-looking palm afforded for the purpose, and for many other useful purposes also. Since the trade in palm fibres has been established, many poor Indians are constantly employed in collecting them, and bringing the large bundles in their canoes down the smaller rivers which flow into the Amazon, and so on to the sea-coast. The cost is not much there, only one shilling for thirty-two pounds of fibre, and that will make a great many brooms, which are sold here at one shilling each; so everybody has a good share of the profit. The art of manufacturing the fibre has much improved lately, and matting is made of very durable quality and good smooth surface. Formerly the chief working of the fibres was at Para, where the Portuguese government had an establishment for making cables for ships. The supply will, no doubt, suffice for all wants, for every year there is a fresh growth of leaves, and the sheaths at the base of their stalks are composed of the fibres. The tract over which this kind of palm flourishes, extends three hundred miles square;

and it is said that several hundred tons are collected annually, at Para, and are nearly all taken away in English ships.

Now let us look at another part of the globe, in the region of palms, and ascertain what valuable materials the natives obtain from the trees. If we observe the state of the vegetation in the Moluccas, or Philippine Isles, in the Indian Ocean, we shall find there the sugar-sago palm growing very plentifully. The large sheaths of the clusters of flowers secrete a large quantity of sugar. This is obtained by cutting them whilst on the trees; the juice flows out, is boiled, and then becomes a kind of sugar, used for various purposes. When the tree is drained of this sweet fluid, it is cut down for the sake of the pith of the stem; sometimes one hundred and fifty or two hundred pounds is got from a single stem, and made into sago. The leaf-stalks yield about six pounds of strong fibres, which are used for ropes, mats, and all similar purposes. The tough midribs of the leaves are made into arrows for the Indian blowpipes; and a woolly substance, at the base of the leaves, serves to stuff cushions, to caulk ships, and for

tinder. The young and tender leaf-bud is eaten as a delicacy, like that of many other palms. The real sago palms of the Indian Isles are excessively luxuriant in growth; one tree yields as much as three hundred pounds of the starchy substance which is made into the small round grains called sago. Several kinds produce sago of different quality, but all of a very nourishing, wholesome nature. The seed of the sago palm has no eatable pulp around it, but is encased in a hard, polished shell, formed of overlapping scales, of a rich brown colour. These seeds may be often seen in shops in sea-port towns, where sailors bring them from the ships which have returned from the palm countries.

In the north of Africa, in the countries named Morocco, Algeria, and Egypt, the date palm is of the greatest value to the inhabitants; from the centre of the crown of leaves, at the top of the stem, grow several bunches of the fruit; one cluster contains as many as seven thousand dates; one tree, near the habitation of a native family, affords nearly all the nourishment they require. It grows also in Arabia, and travellers across the desert take with them a supply of

dates as their chief food. The fleshy part is sweet, pleasant, and exceedingly nourishing, being so full of saccharine juice that the fruit will keep for a long time in a wholesome state. I have said that palms cannot grow in this climate; therefore it is not always easy, or possible, for students who wish to learn about them, to obtain any examples for study. Some young persons will say, How can I examine a palm, or find out anything about it? let me learn, rather, about those trees and plants which grow in our fields and gardens, where I can see them, their flowers, and their fruits. For this reason I endeavour to select English plants, when they can serve our purpose; but there are many things in the natural history of plants which they cannot teach us. Moreover, it is not so difficult, or so impossible, to find out traces of things, by which we can ascertain more, as we may be apt to imagine. Suppose you buy a few dates; you know now, if you did not before, that they are the fruit of a palm; you would like some proof of this, but you cannot see the clusters of fresh fruit growing on the trees. No; but you may examine the fruit,

and there find a certain indication of the truth. At the end of the fruit there is very often a hard dry remains of what was the calyx of the flower; it is of a tough, durable nature, and stays with the fruit as it grows, after the petals have fallen away. Now, of what is this calyx composed? Of three rounded scales, exactly such as we have learned belong to the whole palm tribe. Should you wish for another proof of the nature of a date fruit,—having eaten the pleasant, pulpy part, sow the hard stony seed in a pot of earth, and cover it with a glass from the cold air. In a few weeks you will see springing up a single shoot with only one seed-leaf,—a kind of sheath, clearly belonging to the great class of which the palm is the chief type. As the plant grows, a long slender leaf appears with straight veins to the end; so, likewise, is it with grasses. But is there no peculiar sign of a palm?—Yes; the leaf is plaited in sharp folds; so you need have no longer any doubt that the seed is that of a palm. There will be, however, one more satisfactory agreement with the laws of growth in palms: the seed will, in a few days, make its way out of the earth, and

lie there at the foot of the plant, a mere empty shell; for it has parted with all the hard substance of the interior, to feed the young plant, as all seeds do. Still there is evident, the true character of a date-palm seed; the plant has sprung forth from the small round scar on the back of the seed, and from thence the stem has gone upwards, and the root has gone downwards. The seed did not split in half, as those of the other great class of plants, with branches and two seed-leaves, always do. You perceive, therefore, that they who seek will find; that the wonderful laws which control vegetable life are not all hidden mysteries to us; that we may have the delight of discovering something; that it is still true what the wisest of kings said two thousand five hundred and fifty years ago, concerning the search after knowledge and wisdom, "When thou hast found it, then there shall be a reward."

There is another most valuable palm of the East Indies, the fruit of which is commonly seen, known, and eaten in England; that is the cocoa nut. These nuts are often brought over in their entire state, with their curious outer case of

brown tough fibres, of extreme strength, and smooth on the exterior. It requires some skill and trouble to cut through the outside; within is the seed and its hard shell; to get at the eatable portion, which is the white lining inside, you must use a sharp saw to cut through the shell. The hollow cavity is filled with an agreeable juice, good to drink, when the fruit is sufficiently fresh as well as ripe. At one end of the seed there are three round spots, out of one of these the future plant will come forth if the seed be sown in the ground. We have spoken, in the chapter on seeds, of the manner of their growth, and by what means they attain the power of absorption, and how the soft, tender bud is enabled to penetrate the covering of the seed, and rise up through the earth that lies upon it. It must in any case be a mighty power of life, and in the instance of this strong seed of the cocoa-nut palm, we are amazed at the strength displayed by a slender shoot. We found it difficult, even with a sharp blade of a knife, to cut through the fibrous covering, and observed how hard and tough was its nature, for one strip of the fibres is strong enough to

suspend the weight of the whole nut. The store of white albuminous substance is for the support of the young plant, and becomes quite exhausted whilst the great seed lies at its base on the ground, after the manner of all palm seeds. The original native country of the cocoa-nut palm is supposed to be Ceylon, where, on the coast of Colombo, there is a grove of one hundred miles scarcely interrupted by any other trees. They are also abundant on the coast of Malabar; and it is remarkable that salt air is favourable for their growth; the finest plantations are always on the sea-shore, and the trees bend towards the sea, instead of being turned from it, as is usual with most kinds of trees. When the nuts are planted, a quantity of salt is always put in the hole with each seed. These valuable palms are now transplanted into South America, and on the shores of the Gulf of Cariaco immense plantations of nine thousand trees or more may be seen. It is in the East Indies, however, that the cocoa-nut receives the greatest veneration; the Hindoos have a caste of people especially devoted to its care and cultivation, and will not suffer a single tree to

be cut down. In Ceylon, it is to many the staff of life, and a certain resource for daily food, one tree generally producing one hundred nuts in the course of a year. So continual is the development of fresh flowers, that the tender unfolded bud, the expanded flower, the soft unformed, and the ripe fruit ready to fall to the ground, are all existing on a tree at the same time. The principal cause of decay in these palms is when a beetle pierces its way through to the flower-bud, for the sake of its sweet juice; if the cultivator can guard against this injury, a tree will continue to bear fruit for at least sixty years. New plants must be raised from the nuts; at the end of a month the roots penetrate the hard shell, and gradually descend deep into the earth, spreading far and firm; so that a cocoa-nut palm is seldom uprooted by the most violent hurricane of the tropics. The flower-sheaths of some of the trees are cut and drained for the juice, which is called toddy; others are left to become productive of nuts. So large is the mass of the flowers, that one cluster will yield the luscious fluid during thirty days following. The weight of the fruit, when

the hard nuts are fully grown, is immense; but the strength of the stem is proportionate to the burden, the fibres being of extreme toughness and elasticity, and uniting all parts in a manner peculiarly adapted to the end required. Rope made of the fibres is called coir, and is preferred to any other kind for all ship purposes in the East Indies; it is not injured by sea water, therefore need not be covered with tar, as ropes made of hemp usually are. Lately, coir has been brought to England in large quantities, and is much employed for various purposes. There is still another very valuable produce of the cocoa-nut palm, which was long ago known to the inhabitants of all the countries of the East where the trees abound, but has only of late years been used in this country. The nuts contain oil of excellent quality for burning in lamps; and for this purpose, as well as for the composition of candles, is now very extensively employed.

The gradual manner in which many beneficial objects are discovered and brought into use is very curious. The owner of a large sugar plantation in Jamaica was accustomed for many years

to import from England oil for his lamps; but, after a time, found that the cocoa-nut palms, which were planted as ornaments about his dwelling-house, could supply him with ample abundance. In the year 1840 some English candle-makers were induced to try what use could be made of the oil of the cocoa-nut; finding it very valuable for the purpose, and superior in many respects to tallow, it was not long before large quantities were required. In the extensive candle manufactory at Vauxhall, about thirty-two tons of candles were at that time made in a month, partly composed of cocoa-nut oil. So rapidly did these new kinds of candles gain favour, from the purity of their light, that in the course of a few years upwards of seven hundred tons were manufactured in a month, in the same factory. During the war which began between us and Russia in 1854 the trade in tallow was of necessity stopped; it was therefore very fortunate for us that the oil of cocoa-nuts was already in general use.

There is another instance of the use of palms in giving light, which is of great value in some parts of Brazil. The wax palm has a lofty stem

of a hundred and eighty feet; from the spaces between the leaf-stalks there exudes a quantity of a substance composed of wax and resin ; this is collected, and affords a brilliant light to the miners who work in the dark silver and other mines of Brazil and Columbia.

We cannot learn about any country in the hot regions of the world, without perceiving that palms are most important trees, surpassing all others in the variety of materials they yield to the inhabitants, whether natives, or European settlers in a strange land. If we inquire what is the chief occupation of young boys and girls in the island of Java, within ten degrees south of the equator in the Indian Ocean, we shall find it to be weaving baskets and bags of the young leaves of the Gebang palm, one of the most useful species of all India. They also make broad-brimmed hats, to shade them from the scorching sun, with strips of the leaves neatly fastened together. From the fibres they make fishing-nets and garments ; ropes from the twisted leaf-stalks, and various other articles very useful for all kinds of purposes in their manner of life. The extensive cultivation of rice in Java

could not be carried on without the help of industrious children and the palm-trees; there would be no baskets to gather it into, no bags to send it to England in. The pith affords sago, the roots medicine, and the large leaves thatch for the huts.

Let us observe what some young Egyptian children are eating, as they sit under the shade of a tree that resembles a palm; it looks very much like English gingerbread, but it is not that; it is the brown mealy rind of the fruit of the doum palm, which some travellers have named the gingerbread-tree of Egypt—a relishing food, and easily obtained by poor children.

When Chinese or Indian vessels take in their cargoes at any of the ports of Sumatra, Malacca, or Cochin China, all in the region of palms, one article of their trade is certain to be packages of the nuts of the areca palm. They are about the size and shape of a nutmeg, and are cut into thin slices and wrapped in the leaves of the betel-pepper. They are strongly narcotic and intoxicating; and have become so necessary to the imagined comfort of almost all the tribes of Eastern Asia, that they would rather lose their

daily food than their favourite areca nut. We must not be surprised that the ignorant people of these heathen countries become the victims of a bad habit; for we know that even they who live in enlightened and civilized countries are liable to such weakness, thereby injuring their health and stupifying their minds.

On the other side of the globe, in the rich soil of Honduras, the most south-eastern province of North America, there are groves of the cahoun palm, forming arches of shade with their feathery crowns from the intense heat of the tropical sun. It is not so tall as many other palms, but has many offsets springing up from the base of the stem. One tree produces three or more clusters of fruit in a year, each containing about eight hundred nuts the size of a turkey's egg. The natives break the outer shell, and bruise them in a stone vessel; when boiled, a clear oil flows out, as much as a quart from a hundred nuts. The shell is hard, like that of the cocoa-nut, and can be polished and used for drinking cups.

Now we will notice one very valuable use of palms to ourselves; and, indeed, to almost every nation. Any one who has travelled on a rail-

way may have observed, when a train stops at a station, that a man passes along the line of carriages, carrying a box of bright yellow oily substance, and puts a lump of it into the box of each wheel, to prevent overheat and taking fire from the rapid motion of the carriages. But what is the grease that he thus uses? It looks quite different from the black stuff which was formerly used for such a purpose. What is it? and where is it brought from? Some years ago several English ships were trading off the west coast of Africa, called Guinea, seeking for whatever might be useful to us, and collecting from the negroes what they had to exchange for knives, common tools, or even glass beads for the women and children. They perceived that one palm in particular yielded a thick yellow oily material; it seemed likely to be useful, so they brought away several casks of it. When it arrived in London it was examined by candle and soap makers, who soon found out that it could be made into excellent candles and soap; and, moreover, that in its original state it was so oily and thick, that it might be used in making grease for the wheels of carriages. This was, indeed,

a most well-timed discovery; for, in these days of constant rapid travelling on railways, it would have been impossible to supply enough of the sort once used.

But there is a subject of deeper interest connected with this new trade in palm oil; and it is one which proves to us how the Almighty disposer of all things leads and guides all to good results; showing how a trifling event, of which we think but little at first, and see not any consequence likely to come from it, does in God's good time cause vast benefit, and work changes beyond our foresight and expectation. You know that slavery still continues in some countries of the world, although the English have long ago entirely given up the wicked practice of taking poor negroes from their native land of Africa, to make them work as slaves in America or the West Indies, and have done all they can to prevent the ships of other nations from carrying on the dreadful traffic. Yet there are people in North and in South America, and in the West Indies, who continue to employ none but black slaves to labour in the sugar and coffee plantations. The sufferings of the poor

creatures are often extremely great; first, the separation of families on leaving Africa; then the miserable life in the ships crossing the wide ocean. The captains know it to be an unlawful traffic; and therefore they try to conceal the poor slaves, keeping them in the lower part of the ship, crowded together in a very terrible manner, deprived of fresh air, food, and even water in sufficient quantity to quench the thirst felt in those excessively hot regions. I believe it is impossible for any of us in this temperate climate to imagine what the extremity of thirst is; we cannot realize what even this one trouble of the poor slaves is.

But I do not wish to distress you by speaking too much of this sad subject, which exceeds in cruelty any other in the whole history of the world. I would rather tell you how the noble tribe of palms has been the humble means in God's providence of helping to lessen the horrors of the slave trade. For many miles along the south-west coast of Africa, where the oil palm trees abound, the slave merchants had for several years past built rude huts, into which they brought down from the interior droves of

poor negroes, men, women, and children. There they kept them until a sufficient number were collected to fill a ship; and even then, sometimes there was a weary waiting, for it was not always possible to bring a slave-ship near to the coast; if a British flag were in sight, no captain dare venture near. All Christian people may rejoice to know that our English merchant ships now frequent the coast in such increased numbers, for the purpose of fetching away casks of yellow palm oil, that the wicked slave captains can very seldom come there, knowing they could have no chance of escape. The wretched barracoons or huts are left empty, to be blown away by the hurricane; and the poor negro families are no longer in continual dread of being captured, separated, and carried away across the Atlantic Ocean. The new negro colony of Liberia is becoming a flourishing land of civilized black people, adopting all the first arts of life; having a king, officers, and ministers of their own race, and learning from European missionaries the saving truths of Christianity. Thus we perceive progressing towards its fulfilment that consoling prophecy

of Jeremiah: "They shall all know me, from the least of them unto the greatest of them, saith the Lord." The "good tidings of great joy" which the angel first told to the shepherds watching their flocks by night in the fields of Judea, were not for them only, but "shall be to all people," even to the poor black negroes of Africa.

We have now discovered many things about palms; have ascertained that they were in a remarkable degree destined for the service of man, and do to this day not only fulfil their appointed destiny, but the more the population of the earth advances in wisdom and knowledge, the more use will be made of the varied materials they yield to us. There are still a few objects we have not described. There is a palm in the groves of Peru, at the base of the lofty mountains called the Andes, which has large leaves used for thatch, and a small fruit, full, when soft and not quite ripe, of a clear, tasteless liquid. The Peruvians drink it, and find it agreeable, although it has an acid flavour; when the nuts are fully grown and become hard, the milky juice is changed into a white, hard

substance,—finally looking like ivory. We did not know this kind of palm nuts till the last few years; but now, various little articles, made of this "vegetable ivory," as it has been named, may be bought here. A very beautiful texture it has, and serves many useful purposes. Formerly, before paper was invented, the writers of manuscripts were obliged to exercise their ingenuity to discover any kind of material on which to write. The leaves of trees have been employed in this way, and those of palms being tough, as well as of large size, were not unsuitable. A few specimens of this use of palm leaves there are in our own country. In a library in London, there were once twenty manuscripts written on palm leaves. In the library of the University of Gottingen, in Germany, there is a Bible, written on five thousand three hundred and seventy-six pages of the palm leaf. Another is preserved in the public library of Copenhagen.

Then, we must say a few words of one plant in the great palm tribe, which is a kind of link with the grass tribe, and worthy of observation. You may think it impossible there should be

the least connection between the lowly grasses of our fields and the lofty palms; but remember that all objects in creation are linked and combined in some manner together; no one thing, or being, stands alone in the world; there are endless bonds of union blending and combining even such things as may, at first sight, seem to be wide apart. If we take the largest of the grass tribe, which is the bamboo, we may find an obvious link between it and the rattans, or canes, amongst palms. These canes are only known to Europeans by small portions of their slender stems, sent over and used as walking-sticks. In the uncleared forests of Brazil, they frequently are in length five hundred feet, waving their graceful reed-like stems over other trees like supple ropes, entangling themselves amidst the thick groups of wondrous vegetable forms. In the East Indies they abound also; and, although not all of so great a length, some have long tendrils which climb over trees and shrubs. The fruit of all these canes is numerous, small, and hard, covered with scales pointing downwards from the top, like those of the sago-palm. One property they possess in common with

grasses, that is, a flinty powder exists in their stems. The leaf-stalks, sheaths, and tendrils, are usually beset with short spines, sometimes hooked, which add much to their climbing capacities; and form, likewise, a great impediment to those who explore the thick jungles of Hindostan, or the primeval forests of South America. The vast continent of Australia lies, as we have remarked, within the limits of the palm climate; but the interior of that country has not yet been explored, and so few palms have been discovered, or described, even on the coast, that we have nothing at present to say about them. At the Cape of Good Hope palms do not exist, the soil and climate being, probably, of too dry a nature for them.

There is one small, yet remarkable country, just within the palm region, which must not be omitted, that is the land of Judea. Let us recall what the Jews in ancient times knew, or thought, about these trees, of which a few species, certainly, grew there then, as now. Palms are mentioned several times in the Bible; the first, in the twenty-seventh verse of the fifteenth chapter of Exodus, when, the Israelites

having passed safely through the Red Sea, "they came to Elim, where were twelve wells of water, and threescore and ten palm-trees, and they encamped by the waters." Palms generally flourish best by the side of water, or in moist ground. The finest palms of Palestine were said to be in the neighbourhood of Jericho and Engedi, on the banks of the Jordan. Again, in the book of Judges, we read, "that Deborah, the prophetess, who judged Israel, dwelt under a palm-tree, between Ramah and Bethel in Mount Ephraim, and the children of Israel came to her for judgment." The palm of Judea is chiefly of a dwarf size, not more than twenty feet high, therefore affording a good and pleasant shade under its crown of large leaves. David thought the palm a fit emblem of an upright good man, "The righteous shall flourish as a palm-tree." So grand and majestic in appearance is the palm, that it has been, in all ages, considered as a symbol of victory, and its leaves have been used as a token of honour to great men and kings. It is written that when our Saviour entered Jerusalem, a few days before his crucifixion, the people believed

him to be a king,—"And when they heard that Jesus was coming to Jerusalem, took branches of palm-trees, and went forth to meet him, and cried, Hosanna, blessed is the King of Israel that cometh in the name of the Lord." The custom of carrying palm branches, on the Sunday before Good Friday, is still kept up in this and other Christian lands, in remembrance of this event. They are, however, not real palm branches, or leaves; because, as they cannot grow in this cool climate, it would be impossible to have them. What is used, is sallow, a shrub of our hedges, which puts forth its clusters of green flower-buds in the early time of the year, before the leaves are ready. In Italy, where the air is much warmer, palms can grow, and the children have some of the young, unfolded leaves, to carry about.

There is one more instance of palms mentioned in the Bible, which is worthy of our attentive consideration. In the last book of the Holy Scriptures St. John describes the blessed vision he saw of heaven, "And, lo, a great multitude, which no man could number, of all nations and kindreds, and people and tongues,

stood before the throne, and before the Lamb, clothed with white robes, and palms in their hands." Who were these conquerors with such emblems of honour and victory?—"These are they who have come out of great tribulation, and have washed their robes, and made them white in the blood of the Lamb." Humble, afflicted, striving against pain, grief, poverty, and, above all, against sin; passing through much tribulation; gaining no palms in their lifetime; yet, in the world to come, St. John foresaw them bearing these undoubted tokens of victory; having fought the fight, having overcome their chief enemy, and been made conquerors through Him, who, with His own right hand, and with His holy arm, hath gotten for Himself—yea, and for them also—the victory. No other emblem could have been selected so well adapted to express to our minds the full meaning of this part of the heavenly vision; but we should not perceive it, unless we knew the history and the wonderful structure and properties of this, the most noble race of the whole vegetable world. And how in all times the folded leaves have been used as emblematic of

the highest honour and triumph, reserved only for those who have passed through some kind of warfare, and made peace at last. In this, as well as in all other subjects, we shall do well to listen to the wise king: "Incline thine ear to wisdom, and thine heart to understanding."

CHAPTER IX.

ON CORN, SUGAR, AND VINES.

We have in the last chapter described a very large tribe of plants, yielding nourishment to millions of the inhabitants of the hot regions of the world. The valuable palms supply not only all requisite materials for clothing and dwellings, but also the chief food to the natives who live in the same wide district of the earth's surface. But we have discovered that they do not exist beyond a certain limit of climate; therefore, although some of the materials they furnish, and their dry fruits, may be, and actually are, carried to any other part of the world where man desires to have them, yet those people who live in the temperate regions, as we and all Europeans do, must not look to palms for our daily subsistence. The sick may find sago a suitable nutriment, when appetite fails for more substantial food; and children may be pleased to buy a slice of the white, pleasant-flavoured kernel of the cocoa-nut; but no one

reckons on such tropical productions for their principal support of health and strength. We must seek our "staff of life" elsewhere, in some other tribe of plants nearer home—one which thrives in the same cool climate as ourselves.

We have already spoken to you of the grass tribe; it is one that abounds in this country, and offers to all who study the nature of plants a clear illustration of the extensive class of plants having one seed-leaf, and straight stems and leaves. Since the creating word went forth, "Let the earth bring forth grass," this tribe has been the most abundantly spread over the surface of the earth, and may be considered as one of the most important throughout the whole range of vegetation. Nearly all the species are small in size, but, having spreading roots, extend over vast tracts of land in all regions where the temperature is moderate. In its simplest form of grass, as pasture, it affords large supplies of fodder for cattle; and thus indirectly produces the most strengthening kind of food for man. In the tropics grass has a different character; it does not grow in widespread masses of uniform surface, but the

species are in general tall plants, and for the most part stand singly.

Before concluding our observations on palms, we found there was a link between them and grasses; it is not to be seen in the lowly grass of our meadows; but the bamboo is a tall, graceful, rapid growing species of the tropics, and shows very obviously a resemblance to the slender reed palm of East Indian jungles. There is another invisible link, only to be discovered by thoughtful study, yet very clear to our comprehension when we consider the subject. There is an extraordinary degree of strength in all parts of palms, especially in the leaves; they are so tough and impenetrable, that when they are laid over the roof of a hut, they remain uninjured for many years, and effectually shelter the inhabitants from heat or storm. For this purpose of thatch to a humble dwelling, the inhabitants of many parts of England use straw, the stems of corn, from the tops of which all the grain has been beaten out. What property is it that renders the leaves of a palm and the stalks of corn so peculiarly fitted to cover a roof? Flint is one of the hardest materials of

which the world is composed—"as hard as flint" is become a proverb; well, if we burn palm leaves or straw, the ashes will be largely composed of small particles of flint. All other portions will be destroyed by the heat of fire; but the flint remains. In the ashes of oat straw there will be sixty-eight parts out of a hundred pure flint; whilst in those of the potato there will be only four parts in a hundred. Whenever a stack of corn or hay is consumed by fire, masses of a glassy substance are found in the ashes very abundantly; and the straw of all corn may be melted into glass. This is the chief reason why the stems of corn are so strong in resisting the force of wind and rain, and, even when laid low on the ground by a summer tempest, have power to rise again into an erect position. No other herbaceous plant could do so, even when not laden with the weight of the full grain. Here we perceive one of those instances which we have remarked before; a common fact is seen and noticed, but the cause is not sought for or known. When a fine crop of wheat, nearly ripe, is suddenly beaten down by a heavy storm of rain, as very

often happens in the month of August, it does not occasion so much dismay as might be expected; for most persons know by experience that in all probability it will rise when the sun has dried it.

Before we proceed to speak of the provision for man's nourishment contained in this far-spread tribe, let us endeavour to gain some idea of its general appearance and character. Almost all the grasses which grow in Europe, and are valuable as affording fodder for cattle, are dwarf; that is, they do not rise, when in their fullest development, above two or three feet in height; a great number are not so tall. The most usual aspect of grass is a thick, soft turf, kept low by the continual feeding of cows and sheep; in this state it forms a most beautiful covering to the earth, pleasant to walk over, and very refreshing to the sight, contributing largely to the verdure which is so inexpressibly delightful to behold.

In hotter countries the pasture grasses are even more luxuriant than they are here. Nothing can exceed the richness of the meadows in the fertile valleys of Switzerland, and the higher

pastures on the ridges and in the lofty districts of the Alps, where the cattle feed during the summer months. In South America we should see a different form of grass; the species that grow on the banks of the great Amazon river are, generally, six or seven feet high. In Australia, the kangaroo grass is of equal height; and in the Falkland Isles, lying near the east coast of the southern extremity of South America, there is the tufted tussac grass, said to afford an extraordinary supply of excellent fodder for cattle, rising to, at least, five or six feet. Other kinds of grass growing in single plants, are of much greater height in the tropics; some of the reed grasses of Brazil are thirty or forty feet high, and measures six inches across the stem. They are hollow and jointed, as so many of this tribe are; and contain in the young plants a cooling liquid very refreshing to hunters in that wild country, where thirst is often a cause of intense suffering. The tubes from which the Indians of Guiana blow their poisoned arrows, are frequently made of pieces of a hollow reed cut between the joints, the plants being sometimes sixteen feet long. If we in-

quire of travellers what kind of grass is common in the East Indies, they will tell us that a few of our European meadow grasses flourish on the plains in cold weather; that many others are to be found on the lower ranges of mountains, where the air is much cooler than on the plains. But those grasses, which belong more particularly to Hindostan and its hot climate, are of gigantic size,—forming jungles, thick and tangled, and high enough to conceal herds of elephants or rhinoceros.

If we search into the appearance of grasses, southwards from England, we shall perceive that they increase in size; if we advance northwards, they will appear gradually less,—till the species that cover the plains of Spitzbergen, on the verge of the Polar regions, are diminutive plants, only a few inches above the ground. On mountains of Europe, grasses ascend nearly to the limits of perpetual snow,—forming a close, compact turf of small, tufted leaves; diminished there in size, because the air is as cold in those elevated situations as it is on the plains of more northern countries. The increase of height and breadth of leaf is perceptible, as we travel towards the

south. The largest species we have is the tall reed-grass, in wet ditches about our south-east coast. In the north of France it grows much taller in the old moats of the fortified towns. Further south in France, there is the water-reed, much surpassing it in height and size of stem and leaf, assuming an almost tropical aspect. Thus, proceeding towards the equator, we shall find the smaller species of grass become fewer, and the larger kinds more abundant,—till, in the hot climate of Hindostan, the noblest of all the tribe, the slender bamboo, adorns the forests with its lofty stem and elegant foliage. In the thickly wooded hills of the Malabar country, the bamboo groves form an extraordinary scene; sometimes they seem to have taken entire possession of the land; no underwood obstructs the view; the stems stand in clusters, fifteen or twenty feet apart; their cylindrical columns rising to eight or ten feet without leaves. The number of trees, in each group, varies from twenty to two hundred, and the height from the ground to the arches formed above, by the gracefully curved summits, may be from sixty to one hundred feet. The joints

of the stem are twelve or eighteen inches apart. From these rings spring delicate branches, ending in a narrow leaf. It has been said that a bamboo is the most graceful tree in the world; and when seen in its native land, forming extensive groves of elegant stems and light feathery foliage, or rather branches, overhead, few would be disinclined to allow it such superiority of honour. In the large conservatory of the Royal Gardens at Kew, there are specimens of bamboos sufficiently lofty to show their character and beautiful manner of growth.

Before we examine any more of the wonderful productions of the tropics, let us recall the subject of our research in this tribe; we have to describe that one valuable portion of this group of plants, which furnishes sustenance to the many millions of the inhabitants of temperate Europe. The different species of corn are to us of the greatest importance, and so were they in ancient times; for the lands first inhabited by the human race are all within the range of the climate favourable for the growth of corn, and it very early became an object of cultivation and care. It is not known where corn was dis-

covered in a natural state, or whether it was brought to its present perfection by the art of culture. The origin and source of this precious seed is a hidden mystery to us, and on that account it is placed, as it were alone, above every other article used by us as food. It has been in all times employed as a symbol of higher things when made into its most complete form of sustenance—*bread*, and signifies to us far more than is expressed by the mere words, "our daily bread." We hear of it from the earliest mention of the manners and customs of civilized life; the world was not yet two thousand years old when already bread was evidently the "staff of life," just as it is considered now in all those countries where corn grows. We read of the patriarch Abraham, whilst sitting at the door of his tent on the hot plains of Mamre, receiving three strangers, and with true Eastern hospitality immediately offering them "a morsel of bread." We perceive, moreover, that it was not considered any degrading work to make bread; for though Abraham was very rich, and had men servants and maid servants, yet he said unto Sarah his wife, "Make ready quickly three

measures of fine meal, knead it, and make cakes upon the hearth." We read also of the leavened and unleavened bread of the Israelites, which proves that they were well acquainted with the different methods of preparing bread. It is to be remarked likewise, that some of the old ways are still practised in those very countries spoken of in the Holy Scriptures. We are told how the prophet Elijah lay and slept under a juniper tree, weary of his life on account of the threats of the wicked woman Jezebel. In a dream an angel came to him, and bade him arise and eat; and Elijah "looked, and behold there was a cake baken on the coals." This method of baking bread on coals is exactly what may be seen at the present time in Arabia; the wandering tribes of the desert make cakes, round balls of dough, which they place among the coals to be baked, whenever they do not possess a gridiron on which to bake thin flat cakes.

In all the countries of Europe we find different forms of bread and various qualities of it; but still, bread is the chief article of nourishment, amongst the poorer classes more especially. Since, then, there is so much interest attached

to it, it is quite natural and reasonable that we should wish to learn something of the source whence the material for it is derived. You know that corn is the substance, and that the plants which produce the several seeds called by that name belong to the grass tribe, the same which feeds a very large portion of animals. Let us look at the map of the world, and observe what countries are in the climate suitable for the growth of corn. All Europe is included, excepting the most northern countries of Lapland and Finland, and part of Russia; there, not even the hardy kinds, rye, or barley, or oats can thrive, so bleak is the air, and so little power of heat has the sun during the summer. In the north of Africa corn grows well. In Egypt, we know, wheat flourishes exceedingly. You remember what a plentiful harvest there was there for seven years following, when Joseph stored up corn for King Pharaoh, enough to supply the wants of the people for the next seven years of famine; and not only sufficient for the Egyptians themselves, but for all those who came out of the land of Israel and all countries to buy corn. The Egyptian corn is not like ours, but thick and

branching in the ear; it requires a hotter climate than that of England, although it has been cultivated in small quantities in particular places. All Palestine, part of Arabia, Persia, and the high tracts of India and China north of the tropics, contain corn districts; but other plants there yield to the natives their chief means of subsistence.

Rice, another plant of this grass tribe, we have found before, requires greater heat and moisture than our English climate affords; therefore, when corn is no longer the suitable plant for cultivation, rice takes its place. In Hindostan this occurs, and rice is the daily food of many millions of the Hindoo race, who, from their religious principles, eat no animal meat.

Throughout a great portion of North America, wheat corn will grow, but the principal species is maize, or Indian corn, as it is called; this belongs to a warmer temperature than other kinds of corn, as we can easily perceive. If any one here wishes to have some, he must sow it in a sheltered sunny corner of a field open to the south, that it may have the full benefit of the heat.

As we travel southwards through Germany, a few days will bring us into the region of the maize corn; and very beautiful it is, with its large leaves on the stout stem, surmounted by the feathery cluster of small flowers, or later, when the bright golden seeds are ripe and the large grains appear in a mass, bursting forth from the sheath in which they had been wrapped.

In South America, the only region for corn on the plains is in the extreme south; but many Europeans are now settled in flourishing colonies on the west coast, at the base of the lofty range of the Andes. They took with them their native taste for wheaten bread, and what man desires earnestly he can generally find ways and means of accomplishing. So, after a time, they discovered level districts on the lower ridges of the mountains, five thousand feet above the plains, where the climate very nearly resembles that of England. Here, therefore, corn-fields may be seen; and the English settlers are enabled to enjoy wheaten bread, a luxury to them even amidst the rich abundance of tropical fruits.

New Zealand, in the southern ocean, is most favourably situated for the growth of corn; and, already, extensive districts have been cleared of useless shrubs and plants, and the soil brought into a condition fitted for its cultivation, producing more than is necessary for the scanty population, and adding to the stores of the colonists in Australia, where the southern parts alone are cool enough for corn.

In the chapter on flowers, we described those of the whole grass tribe; no petals of bright colour or expanded form; only small, dry, folded scales, protecting the young tender seed until it is grown to a full size and hardened. Whilst unripe it is soft and full of a milky juice, and would, therefore, be exposed to the attacks of birds for their food; but the scales, or husk, or chaff, as it is occasionally called, enclose it safe from harm. Of all the varieties of corn, wheat is most esteemed for man's use, and makes the best bread. Barley is chiefly used in the state of malt, that is, after having been heated and suffered to swell and begin to grow; then it forms a chief ingredient of beer. In Scotland, where it is too cold for wheat to

flourish, barley is used by the Highlanders for cakes. Rye can grow further north than wheat, and supplies the remote northern countries with a wholesome kind of brown bread. In the north of Germany, especially in the province of Westphalia, rye-bread is made of very excellent quality; almost black in colour, very solid in substance, baked twenty-four hours in the oven, keeping fresh for many weeks, and much relished by all ranks. A commoner sort is made for horses, and serves them for a part of their regular fodder. A driver will not start on a journey over the sandy heaths, or along the more trodden high roads of Westphalia, till he has deposited in some place in the carriage a store of rye-bread for his horses. When he stops to rest by the way, he cuts it into pieces for them, and they eat it as English horses do oats.

In the north of Scotland oats furnish the cheaf supply of meal; the peasants make of it thin cakes, which are eaten at all times, instead of bread. Oatmeal porridge is the common food of young children, and is extremely wholesome for them. In the towns and villages,

about noon, they are to be seen sitting at their doors, with a wooden porringer full of the nourishing meal. The size and shape of oat-cakes vary in different parts of the country: the Scotch cakes are small; those made in the Craven, and other remote districts of Yorkshire, are more than a foot in length, of an oval shape; whilst moist, they are hung up over strings fastened to the ceilings of cottages, ready for use; if a poor beggar come for help, a bit of oatcake is the alms given. Gradually, however, these primitive customs wear away; and the yearly increase of travellers, in all parts of England, causes change, and the introduction of modern habits,—that of eating white bread amongst the number.

Besides all these kinds of corn, known to and used by Europeans, there are several others very common in hot countries. That called millet is used in India, and also in the eastern parts of Europe; and the seeds of various smaller grasses afford a nourishing food to the poorer classes in many countries; very few are unwholesome in this extensive tribe.

Of all the plants cultivated for food, corn

ranks highest in the quality of the nutriment contained in its seeds, farinaceous matter and gluten being combined in them. Wheat makes the finest flour, and has the largest proportion of gluten; and this property is more fully developed in the south of Italy than in England, the heat of the climate being greater. For this reason, the macaroni made at Naples is superior to any made here of English wheat-flour. Neapolitan macaroni has always been considered the best; but it is not generally known why it is so, and of late years manufactories for it have been established in London: the macaroni, of course, is as well made as at Naples, but the quality is of necessity inferior. Gluten is the cause of fermentation in bread, and is the chief ingredient of nourishment. Starch is obtained from wheat by steeping it in water and beating it in bags; this is a very valuable substance, of endless use.

In considering the immense benefit yielded to mankind by the grass tribe, we must not omit due mention of the sugar-cane, a plant of the reed kind, belonging to this valuable group of plants. It grows with a jointed stem, to the height of twelve or fifteen feet, bearing on the

top a most graceful drooping tuft of flowers. From the joints spring the long flat leaves; the stem is not hollow between the joints, as other canes are, but solid, and filled with a remarkably sweet juice, which is collected and made into sugar. It is now become one of the most essential luxuries to man, and one of the first objects of care and culture; but in the time of Pliny, a celebrated Roman naturalist, who lived in the first half-century of the Christian era, it was a rare substance, and only used medicinally. He mentions in one of his books on Natural History, which we still possess, a *sweet salt*, called *sakkar*, used in medicine. This is now believed to be sugar. A famous physician of the tenth century first employed this new sweet substance instead of honey in his medicinal preparations. The sugar-cane grows naturally in some of the tropical regions of the world, and is capable of cultivation as far as the fortieth degree of latitude north and south of the equator. It was known and cultivated in the ancient empire of China for about two thousand years before it was introduced to Europe, or the neighbouring eastern countries. Travelling

merchants first transported it to India, thence to Arabia; but for some time it was supposed to be a mysterious production, for the Chinese, always jealous of intercourse with strangers, kept the art of manufacturing it a profound secret. No foreigners were then permitted to enter their country, but received the articles of traffic at the ports. Merchants, therefore, had no opportunity of ascertaining the nature or growth of sugar, but were acquainted with it only in its prepared crystallized state. Sugar was first brought to Europe by the enterprising Venetian traveller, Marco Polo, in the middle of the thirteenth century. Thence it was carried to Spain; and in due time was conveyed to Madeira and the Canary Isles. Soon after Columbus discovered America, and European ships began to visit the new world, as it was called, sugar was taken to Hayti, and gradually to all the West Indian Isles. In Brazil, it was received, and the cultivation of it begun. A very large quantity is brought yearly to England from the West Indies, as well as from Brazil and the East Indies—the consumption of it increasing continually.

It is remarkable that one of the greatest comforts to civilized man in his daily life, should have been for two centuries the cause of the greatest misery to another portion of the human race. You remember what we said about the horrors of the slave-trade, and the distress it so long caused to the poor negroes. When the happy time shall come that the sugar-cane is cultivated only by free hands, the enjoyment of its pleasant and wholesome juice will be unalloyed. The canes cannot be propagated by seed, only by cuttings of the plants; the ground is carefully dug up, and marked in rows three or four feet apart; in these lines holes are made, eight to twelve inches deep, and the pieces of cane are placed in them. The hoeing of a sugar-cane plantation is a most laborious work, performed under the heat of a tropical sun. It could only be done by black men; and the custom is general of employing negroes, either slaves or free. Lately, a plough has been used in some plantations, which much lessens the labour. It is not necessary to plant fresh canes annually; for the roots of former years being left, spring forth again a second

time. When the canes are not only fully grown, but the sugar juice is perfectly developed, they are cut down close to the ground, tied in bundles, and conveyed to the mill. Here they are crushed by cylinders rolling over them, and the juice is pressed out; this is immediately heated, to prevent it from becoming acid, and to evaporate the watery portion. As the syrup cools, it granulates; it is then placed in shallow pans to harden, afterwards put in casks with holes in the ends, and set upright over a large cistern, into which the molasses—that is, the part which will not crystallize—drains away, leaving the raw sugar in the state we receive it, and buy it here in the grocers' shops. All the fuel used in the process of preparing sugar in the plantation, is the old dried pieces of cane; the chief expense, therefore, is the mill for crushing the canes. It has been calculated that about a hundred canes will yield six pounds of crystallized sugar; the molasses that remain are distilled for spirit. The negroes who work in the sugar fields live entirely, during the cutting time, on the raw cane, and are said to grow fat from its very nourishing properties.

The refining and preparing the white solid sugar is done in Europe. Sugar is a common production in the grass tribe; but in no plant in sufficient quantity to reward the trouble of cultivation, except in the sugar-cane. Maize contains a good deal; and it is probably owing to it that it is so nourishing a grain. In North America maize is cultivated very generally, and affords the chief food of the people, prepared in a variety of ways. In former times the Mexicans made several kinds of bread from maize-flour. The Peruvians of South America used bread of this flour also; and a peculiar kind was kept exclusively for their religious ceremonies.

But I do not wish to weary you with any more descriptions of this valuable tribe of plants; you now know all the chief examples of it which contribute to our daily comfort, as well as the general appearance it displays in the different regions of the world. We can never forget the grass tribe, for it is sure to show itself in every possible place; it seems as if from the beginning the whole earthy surface of the globe had been sprinkled with the seed, and so it

continues to spring into existence everywhere. If the streets of a city are paved with stones, and but few persons or carriages pass along the way, little tufts of grass soon begin to come up between the stones. This may not be often seen in the dry crowded streets of London; but, even in some of the chief thoroughfares of the city of Edinburgh, so few pass by, that grass grows between the pavement. And, in the quiet cities of Holland, children are continually employed in picking out the grass from the stones. Well, then, as we have spoken of the principal characters of the tribe, you will be able to find out more for yourselves, and add to your knowledge when any example occurs. Those who keep singing-birds in a cage, will soon discover whether the seed they feed them with belongs to the canary grass, or to hemp, or any other plant.

Having now learned something of the nature of bread and of sugar, we will occupy the rest of the chapter with some account of the vine, a plant in many ways associated with bread, although they are not connected in the natural groups of plants. When Isaac blessed Jacob,

he prayed that he might have "plenty of corn and wine;" "a land of bread and vineyards" was used to express all that a nation could desire, and throughout the whole Scriptures we know that these two things were taken as types and emblems of all good things, spiritual and temporal, and have been thus exalted above every other earthly produce. The grape-vine ranks highest in the class of fruit-trees; it was among the earliest known to man, and the art of making wine was one of the first discoveries of the uses of those trees yielding fruit which were given to him "upon the face of all the earth." The vine, like some other plants we have studied, has a certain region of the world marked out for it. The tropics will not do for it, neither the cool climates of countries that are situated beyond the fiftieth degree of latitude on the north; therefore the vine cannot grow in the open air except in peculiarly favourable spots or sheltered places in our country, neither in the north of France nor Germany. In entering France on the north, we see no extensive vineyards until we have travelled beyond Paris southward, or into the warm provinces to

the east in the old territories of Champagne and Lorraine. The vine flourishes also in the north of Africa nearly in the same tract of temperature as that of maize. But in central Africa no vines will be found; it is too hot and scorching throughout the tropics of that continent; when the climate cools a little beyond that limit at the Cape of Good Hope, the vine is again cultivated, and much good wine is made and sent to other countries as Cape wine. The vine grows wild about the southern shores of the Caspian Sea at the present time, just in that part of Asia which was first inhabited by the human race. From thence it followed the course of population and civilization; wherever man progressed and cultivated land, there vineyards were planted. How many times they furnished the subject of our Saviour's teaching to the Jews! this proves that vines were generally cultivated in Judea, and also that they were reckoned the chief and most excellent of plants. We hear scarcely anything of others, except corn, yet doubtless many other crops were grown for some purpose.

It is very curious to trace the advance of the

vine; from Asia it was brought into Greece, a country famed for the wisdom and learning of its people for many centuries. Thence it was taken to Sicily, and cultivated there in great perfection; as the Romans took possession of new countries in Europe beyond their own Italy, they introduced the art of planting vineyards, and those which now cover the sloping hills on the banks of the Rhine and the Moselle in Germany are said to have been originally planted by the Romans when they were established in that country. In ancient records of the time when the Saxons became rulers in this land, there are accounts of vineyards, which seem to prove that the Romans had in the course of their four hundred years of dominion taught the people the way to plant vines and to make wine. At that time the climate of England was much warmer than it is now, and the cultivation gradually diminished after the produce of more southern countries increased sufficiently to supply us. When the farmers learned how to cultivate their land with various crops, and the monasteries were broken up, it was found better to grow corn than vines; about three

hundred years ago only a few vineyards, in favourable situations in the southern counties, were still to be seen.

It was not until the beginning of the last century that artificial means were adopted to ripen grapes; the vines were then planted and trained against a wall, on the other side of which fires were made. About a hundred years ago the first houses covered with glass were made for vines. In these hothouses grapes ripen well, and are thought to be as rich and well-flavoured as those which grow in the open air in more natural heat. It is probable, however, that they do not acquire some of their best properties so fully.

We have already observed the tract of the earth's surface on which palms and also corn flourish best; you can now trace out on the map the region of vines. It spreads over nearly two thousand miles in breadth on the north of the equator, including the north of Africa and south Europe. The best part of this region is Spain and Portugal, where the choicest kinds of grapes ripen well, and are made into excellent wine. Even there the

climate varies in its suitability, and those grapes which grow in the southern provinces are chiefly fit to be dried as raisins in the sun. In some districts the grapes must be steeped in a preparation before they are exposed to the sun for drying. This causes some difference in the quality, and is the reason why Malaga raisins are preferred for some purposes and those of Valencia for others.

Vines have a trailing stem that is unable to support itself without some kind of prop, but if that be given they climb over it readily, clinging on firmly by means of the curling tendrils on the branches. The most ancient manner of training vines was upon other trees, and this is still preserved in Italy. One of the striking parts of the scene to a traveller descending the Alps into the plains of Lombardy, is the sight of vines trained to peach-trees in the open fields; their branches forming festoons from one tree to another, laden with purple grapes if it chance to be in autumn.

In some hot countries of the East, the primitive custom of planting vines by a well, and training them over a trellis-frame, is still main-

tained, and the owner and his family repose and refresh themselves under the pleasant shade. This explains the similitude used by the patriarch Jacob when blessing his sons, he likened Joseph to "a fruitful bough by a well." When the fruit is ripe it is gathered into carts and taken home. The very choicest wine, as that of Tokay in Hungary, is the first dropping of the rich juice before the grapes have been pressed. The ancient treading of the wine-press is referred to so often in the Bible, that we know it must have been a national custom. It still remains the common way of obtaining the juice in many eastern countries, and in Italy it is the usual practice, although in some vine districts a kind of press is used. In Spain, goatskins are dried and sewed up into bags to keep wine in; which recalls to mind the illustration used by Christ to his disciples, about putting "new wine into new bottles," lest the wine be spilled. The skins were liable to crack and burst when old, but a glass bottle remains secure until it be accidentally broken.

Concerning the region of the vine in the East Indies, we must remark that it does not extend

in the same latitude as in Europe, on account of the different kind of temperature. The French,—when they took possession of Pondicherry on the east coast of Coromandel, in twelve degrees of latitude,—established vineyards there. In the north-west provinces of Asia the vine thrives well, but in general the grapes do not make good wine, nor can they be dried as raisins. In some parts of the Himalaya, grapes ripen at an elevation of nine thousand or even ten thousand feet, and are converted into wine and raisins. The vines of the luxuriant valley of Cashmere find a suitable temperature at five thousand five hundred feet. In China and Java, also, vines are cultivated. In the New World there is, likewise, a region of vines gradually extending according to the progress of civilization and the art of culture. On the Andes, vines are generally found to thrive where the maize can grow, up to an elevation of seven thousand feet above the plains. From America, vines have been transported to the Sandwich and other isles of the Pacific Ocean; whilst from England they have been carried to, and successfully planted in Australia. All this seems

to be an indication of that future time dawning, which the prophet foresaw two thousand five hundred and sixty years ago,—when peace shall prevail over the earth; when spears shall be beaten into pruning hooks, and "nation shall not lift up a sword against nation, but they shall sit every man under his vine." Young vine plants begin to yield fruit at two years, and are said to improve in quality until fifty years old. Their duration is extreme; for in France and Italy there are now vineyards in existence, which are known to have been in full vigour for, at least, three centuries.

The learned naturalist Pliny, of whom I have before told you, mentions a vine which he had seen when it was six hundred years old. The stem attains a considerable size when all circumstances favour its growth. It is said in an ancient book that two men could not embrace one, which far surpasses the usual size. When the wood is old and compact, furniture is sometimes made of it, and much esteemed for its durability.

The small black grape from the vine of Ascalon and Zante, formerly chiefly cultivated in

Corinth, has no seeds; this kind is dried for use, and is well known in this country as dried *currants*. You can now easily perceive they cannot be real currants, such as we have on currant bushes in our gardens; because you learned in the chapter on *fruits*, that they have the remains of the withered blossom on the top of the berry, but the grape is placed entirely above the flower, therefore is smooth, and shows no trace of calyx or petals. A larger white grape, also without seeds, is when dried the kind we call Sultana raisins. Even this one trifling production of the vine tribe is become an important article of commerce in the present populous state of the world. Upwards of one hundred thousand hundredweight are sent here annually from Spain; a still larger quantity come from Turkey, and a considerable portion also from Italy. Raisins are used in various ways for cakes of all sorts and for puddings. Wine is also prepared from raisins as well as from grapes in their fresh state, and is of excellent quality, preserving its strength and goodness for many years. The fruit is almost equally nourishing and refreshing in its dried state, as

when fresh gathered from the vine. There is very early record of raisins being eaten as food, and affording really strengthening sustenance. When David was at war with the Amalekites, the Egyptian who was found fainting in the field was revived by the food given him; part of which was "two clusters of raisins." Then we read of a present being made to David, one portion of it being one hundred bunches of raisins. And when by general consent, David was made king at Hebron, and "there was joy in Israel," amongst the things which composed the gifts for the feast, were "bunches of raisins."

The seeds of grapes contain a very pure oil, of the same nature as that of the olive. The leaves and tendrils have a peculiar astringent taste, not at all perceptible in the ripe fruit, which has completed the work which the leaves begin,—of converting all the juices of the plant to the formation and perfection of the fruit.

There is still much more might be said about vines; but I would rather you should consider well what you have now learned of them. The vine, and its fruit the grape, stands unrivalled in

the whole class of fruit-trees; it is in every way full of interest to us,—the subject of thoughtful consideration. It would not have been selected, as it was, for a sign of peace and prosperity in a land, unless it were really capable of being so made, neither would it have been taken as a symbol of the deepest meaning to man, if he could not have been aided thereby to comprehend what was best fitted to "make glad the heart." Let us take heed, therefore, that we do not rest satisfied with the mere knowledge of the facts of the history of the vine; but endeavour in this, as in all things, to search out the truth, and what it is intended to teach us.

CHAPTER X.

ON TEA, COFFEE, AND COCOA.

You have now learned enough about plants to be able to understand the general arrangement of any simple example that may come before you; you also have discovered some rules by which you will be enabled readily to distinguish to which of the two great classes of vegetation any plant may belong. A very small portion of it will suffice to ascertain this fact. A single flower, or perhaps a part of one leaf, will often explain to us a long page of its history. In order to render the study of plants easier and pleasanter, skilful naturalists have now, after much patient study and research, arranged large groups of plants, having similar forms of flowers or seed-vessels. Thus, if we gain acquaintance with a few in one tribe, we shall soon find the apparently confused mass become intelligible to our minds, and plants that are connected by outward appearance or similarity of properties are without difficulty retained in

the memory. There are many of these tribes exceedingly interesting to us, as I think you already perceive; that in which several of our most useful fruits are found, the apple, the pear, and others, is an instance of a tribe containing much wholesome and refreshing food.

In a former chapter we spoke of the palm tribe, that which ranks highest in the whole race of vegetable existence, and has the highest claims to our attention from its acknowledged superiority in noble growth and valuable properties. But, as in all other branches of creation, the humble and lowly may often befriend us as well as the lofty and exalted. It sometimes occurs that a tribe of plants contains some species remarkable for beauty of form and colour, others precious for their supply of food, or some other useful quality. We will now examine some examples of a tribe flourishing in China and Japan; it contains one of the favourite ornamental shrubs of our conservatories, the camellia. The glossy dark green leaves, the pure white flowers, or those with deep red petals, are all pleasing and receive much admiration. If you look but one minute at one of

Mont Cervin

The Tea Plant

these plants, you will know that it belongs to the great class of branching stems and netted-veined leaves, you can see that by the whole aspect, even if you could not trace any clue to the class in the flower, that being made by culture to produce numerous petals, instead of its natural number of five.

We will not now spend time on these plants, for they are admirable only to the eye; but they will lead us to another member of the family or tribe that is worthy of our most attentive consideration. Over ranges of low hills, in a particular district of the vast empire of China, grows the tea plant; it has firm glossy dark green leaves, of the same texture and character as those of the camellia; the flowers also are of the same type, five white petals, placed around numerous stamens with their pollen cases, which form a circle about the seed-vessel in the centre. The seeds of nearly all the plants of this tribe contain oil abundantly; the peculiar property which renders the tea plant valuable is in the leaves; it contains strengthening and refreshing powers in a remarkable degree not surpassed or equalled by any other known plant. Tea being

now daily used by nearly all classes of people in England, we will try to gain some clear account of it, what it is, where it is brought from (for all know it does not grow in our fields or gardens), how long it has been the general and favourite drink, and any other particular of it which we can discover.

We can hardly imagine what was the common refreshing beverage before tea was introduced from China, or what substitute our forefathers had. But we are apt to forget what countless objects there are in creation, and also the merciful capacity God has given to man to adapt himself to a variety of things for food, for clothing, and the whole manner of life in every respect. Before the delicious Chinese tea was discovered by Europeans and brought over in the merchant ships, our good ancestors were accustomed to a very simple manner of living, and were not provided with the numerous foreign articles of food which are now collected in our warehouses for the use of the poorest as well as the richest. Let us look back about two hundred and fifty years and read in some old books what was going on in our native country then.

We find that in no part were there any towns so large as many are now; London, our capital city, was at that time no larger than some of the small country towns now are. Almost everybody all over England had either a small garden for herbs, or could procure some of a neighbour who had more than he required. Thus every woman could make a sort of tea of sage, or balm, or mint, or one of those aromatic pleasant-flavoured herbs which are still much used for sauces and additions to cooked meat, and for a variety of purposes. No doubt both rich and poor were contented and satisfied with that kind of tea then, for they had never tasted any better, and it is only when we have once had a superior thing that we are discontented with an inferior one. Well, two hundred and fifty years ago, not even the king or the queen could have had a cup of tea for their refreshment any more than their humblest subjects could. Ships were few and small, and no English captains had then ventured to China often enough to find out what a delightful beverage the Chinese had been constantly enjoying for some hundred years past. Some

Dutch merchant ships were the first to discover tea in the Chinese port, and in 1610 the Dutch East India Company brought a small quantity of tea to Holland. Afterwards they sent a little here as a curious new article of trade; but it is not known when or where it was first sold or used. The only record we have of its early use is in the famous diary of Samuel Pepys, secretary to the Admiralty in the reign of Charles II. He there wrote on September 25, 1661: "I sent for a cup of *tea*, a Chinese drink of which I never drank before." At that time it was only made and sold in coffee-houses, and a duty was paid to the government of eightpence for every gallon that was sold. In 1664, the East India Company of London made a present of two pounds two ounces of tea to King Charles, a very royal gift it was thought then. In 1667, the East India Company issued their first order to import tea to an agent at Bantam, directing him to send home one hundred pounds of the best tea he could procure. There is scarcely any other example to be found more curious than this, of a rapidly increased supply of a foreign article of food.

During the space of two hundred years, what a vast difference! Then, two pounds two ounces of tea were thought a gift worthy of a king's acceptance; now, there are few of the subjects who cannot buy two ounces at least, now and then. Those who can afford to purchase two pounds are beyond counting. I say *afford*, for there is no lack of supply of tea at any time; we never find the stock exhausted now; the only thing is to have the money to buy it with. In the warehouses of the East India Company there is always a whole year's store, and the quantity given out monthly or weekly for sale is continually increasing. In the first week of June, 1856, six hundred and seventy-three thousand and seventy-eight pounds were sold from the store-houses. Before the change of the tax on tea in 1724, the annual consumption of it in England was about twelve million pounds weight. As the sale of tea increased, it was found very troublesome to collect the duty on it when made; the government, therefore, changed the system, and five shillings was paid on each pound of tea, as it arrived from China, before it was bought by the tea dealers

for sale. Until the year 1833, the East India Company had the entire charge of the trade; since then other private merchants have had the privilege to trade in tea. In 1858 the charter of the East India Company was dissolved, and the traffic in tea has now lost its original peculiarities. Whilst the quantity brought from China was small, the price was naturally very high. In 1707, the cost of a pound of tea was sixty shillings for the best quality. In 1756, congou cost eight shillings the pound; green tea, twelve shillings; and fine hyson, eighteen shillings. Now, very good congou, or black tea, is only three shillings and sixpence a pound; and the most expensive of all is not more than eight shillings the pound; therefore, in the course of a hundred years, the lowest price became the highest. In the whole history of commerce, there is no one article so remarkable as tea; the shrub is extremely limited in the place of its growth; yet tea is now carried by merchant ships and other means of transport to all parts of the civilized world, and is thought to be indispensable by those who are once accustomed to the use of it. Through-

out Great Britain it is now considered to be one of the necessary comforts of life to all classes.

Let us consider what part of the globe is its native country, and where it is cultivated and manufactured. The tea shrub is spread over a wide, but peculiarly defined district in Asia, extending from seventeen to thirty-one degrees of north latitude in China; reaching further north in the island of Japan; probably owing to the influence of the sea air, which always causes some difference in temperature.

It is remarkable that the combined favourable condition of heat, soil, and situation is only to be found existing in this particular range of hilly country in the extensive empire of China. So very clearly is the district marked out, that it is called by the Chinese, as well as others, "the tea country," and beyond this tract only a few small plantations are to be seen near the capital city of Canton and elsewhere. It is chiefly on the slopes of hills that tea shrubs thrive best, and generally in a light loose soil, very much like what suits the vine. The Chinese call it *tcha*, or *tha;* European botanists from this gave

it a Latin name, *thea;* we English call it *tea*, and all Europeans by a nearly similar name. The shrubs yield three crops of leaves in the year, from the time they are two years old to about twelve years. The flowers are small, round whilst in the bud state; when expanded the five petals form a round flower about an inch across. These may be seen in summer on the shrubs which have been growing for many years outside one of the conservatories in the Royal Gardens at Kew. The climate of China is one of great variation of temperature, the heat of the summer being much higher than in most of the countries of Europe, and the cold of winter greater. Tea plants, therefore, would not thrive well in the equal warmth of our heated conservatories; they appear to require the changes of the natural seasons of the year. The gathering and preparation of the leaves employ a great number of Chinese, and they are content with very low wages, only about threepence a day; but we must remember that everything is very cheap there, and the wants of the labouring class of the population are but few. If they only have tea, they care for little else besides; the peasants in

the tea countries have each their little tea plantation, just as the English have their cabbage garden, or the Irish their potatoe field. They drink tea many times in the day, quite pure, without either sugar or milk. The mandarins and other great people make it in little cups with a cover, separately for each person. The porters and carriers who convey packages along the roads or over the hills, stop for refreshment at small open shops by the wayside and drink a cup of tea. The properties of tea are of an extremely refreshing nature; an old Chinese author describes it, and the manner of preparing it. He says: "It is an exceedingly useful plant; cultivate it, and the benefit will be widely spread; drink it, and the spirits will be lively and clear. The chief rulers, dukes, and nobility esteem it, the lower people will not be without it; all use it daily and like it." This description will equally well apply to England, and it is almost a solitary instance of our having adopted a custom from a country so remote and so unlike ours in every national habit. The leaves are gathered when quite young and unfolded for the most delicate and highly flavoured teas; for the com-

mon kinds, they are left on the bushes till fully grown. After being gathered, the leaves are dried in shallow pans over a fire, and then rolled in the fingers, a slow process, but the Chinese are patient workmen, and nothing seems to be tedious to them. It is one of the arrangements of the world, evidently appointed by the All-wise Ruler, that the tea plant flourishes naturally in China, where the inhabitants are so peculiarly well fitted for the culture and preparation of it. There is no other race of people in the whole world who would do the work so well; wherever it has been attempted to form tea plantations, as in Brazil, the first part of the plan was to transport thither Chinese labourers. Tea forms the occupation of a vast portion of the population over a very large district, nearly all hilly, called the Bohea or tea country. It is intersected by roads sufficiently good for the traffic, as no wheel carriages are used. The low ranges of hills are nearly covered with tea plantations, and they are the continual object of care and attention. The first gathering of the leaves makes souchong tea. Pekoe is also composed of the young leaves of delicate flavour; in this the

folded slender leaf at the end of the branch is very obvious, covered with pale silvery down. Congou and other commoner kinds are made from the full-grown leaves. There are three kinds of green tea; that called hyson is composed entirely of carefully picked leaves, dried with a less degree of heat than others; this is always of higher price than souchong. The mountain named Singlo, about one hundred and fifty miles south of Nanking, produces an abundant crop of green tea called after the name of the mountain. Gunpowder tea is made of tender leaves nearly of their full size; this kind is sometimes rolled into balls by the hand, and is highly esteemed, costing always more than hyson. Sometimes the soft leaves are twisted into small cords about two or three inches in length, and a few of these twists are tied together with silk. Sometimes a small quantity is rolled up in the silk paper; all such little devices are intended as presents, and are often sent to England in that way in various Chinese lacquered boxes, or canisters made of a peculiar soft metal composed of lead and other materials. In the preparing of green tea a colouring substance is used to dye

it, and it is supposed not to be always so wholesome a kind for tender nervous persons. To many it is disagreeable in flavour, and has, moreover, the unpleasant effect of preventing sleep after drinking it. Whether this depends on the manner of preparing it, or in any peculiar quality of the leaves, is scarcely ascertained. When the tea is ready, it is packed in wooden chests, which are carried on poles by men called *coolies* over the hills, a long journey of six weeks, very often to the port of Canton. Sometimes as many as six hundred chests are despatched at one time. The tea merchants go or send round to all the farms and villages and temples to collect tea, for almost everybody has some to sell, even the priests of the pagoda temples amongst the hills cultivate tea. Those hills with trees surrounding the temples, which you see on the common blue China plates, represent the tea plantations, but are strange designs, like the rest of their odd paintings, and do not give a very correct idea of the scenery. In some parts of the tea country there are small rivers by which the chests are conveyed in boats down to Canton. The tea hills are sometimes very steep and almost

inaccessible even to a native Chinese; when they are unable to reach the shrubs, they attract the notice of monkeys which abound in the groves, and breaking off boughs the monkeys are induced to imitate them and throw down branches of tea plants to the Chinese, who are waiting below, and then quickly strip off the choice leaves.

A few years ago it was thought advisable to endeavour to cultivate tea shrubs on the lower slopes of the Himalaya mountains, on the north of India, where situation and climate seemed favourable, so nearly corresponding to both in China. Accordingly, an intelligent traveller, Robert Fortune, was despatched from England to China, to try if he could procure some seeds of tea, and convey them, with a few Chinamen, to India. He had learned to speak the Chinese language very readily; and he dressed himself after the fashion of the people of the country, and adopted their curious manner of eating with chopsticks, so he prospered very well; and, although the Chinese are always jealous and suspicious of strangers, they were friendly with him, not at all thinking he was an Englishman, only, as he could not speak quite like them-

selves, they supposed him to have come from a province beyond their "Great Wall." He travelled through all the tea countries, which he describes as very beautiful; and he was kindly received by the priests in the pagodas. After a long journey, and a good many adventures, he succeeded in obtaining about thirteen thousand seeds. Lest they might become too dry, and suffer from the change of temperature during the voyage to India, he took the precaution to sow them in boxes of earth covered over with glass, which kept them safe from all injury. He then asked some Chinamen if they would go with him, and teach the poor Hindoos how to cultivate the tea shrubs and make the tea. Now the Chinese are exceedingly attached to their native country; and, if they had not thought Robert Fortune was a real Chinese from a distant part of their own country, they would probably have been unwilling to trust themselves with him. A great number, however, willingly agreed to go. They had a prosperous voyage, and reached the Himalaya mountains in safety. When they unpacked the boxes, they had the satisfaction of finding nearly all

the plants thriving well. Chinese and tea plants, and all the necessary implements and vessels were given over to the English gentleman who was to have the care of the plantations, and all was left in a very hopeful state. But the poor Chinamen were extremely sorry to part from Robert Fortune; they had been treated with the greatest kindness, and had called him "father" all the voyage.

The produce of this new tea country already begins to repay the expense and trouble; and every year it will yield in greater abundance. Without doubt it will prove an immense benefit to the poor inhabitants of India, the hill tribes more particularly. When tea is become plentiful, they will have some resource in the event of scarcity of grain, which very often happens. Besides, the corn or grasses which grow amongst the hills are very scanty, and cannot be sold in any market, for they are far away from towns. The dwelling of a hill country peasant is a mere mud hut, scarcely capable of affording him and his family sufficient shelter, either from heat in summer, or cold and wet in the rainy season.

The extensive use of tea by the Chinese is one of the reasons of their excellent health and activity for labour; whilst the weak, supple frame of the Hindoos, who live chiefly on rice, disables them from hard labour, and causes an indolent disposition both of body and mind. Very possibly in future generations there may be more vigour, when they have been cheered and refreshed by the strengthening and reviving beverage of tea.

In the year 1836, a different kind of tea shrub, having rather larger, tougher leaves, was discovered growing plentifully on low hills in the country called Assam, a large province, comprising the middle and upper valleys of the great river Bramahpootre, which descends into the Bay of Bengal to the east of the Ganges. The lofty range of the Himalaya bounds the country of Assam on the north; it stretches over twenty-two thousand square miles, but is very thinly inhabited, containing only about eight hundred thousand people. The lower districts are often flooded; the hills on which the tea shrubs grow are seven hundred feet high, and seem to be remarkably favourable to

their cultivation. Since the English have attended to this new tea country, the produce has increased yearly, and is becoming of much importance to us as a welcome addition to our stores. The tea has a stronger flavour than the Chinese tea; therefore is not so agreeable to the taste of some persons, whilst others prefer it.

The famous Swedish naturalist, Linnæus, of whom I have before spoken to you, and who was the first to arrange plants in any kind of order, was the first person who succeeded in introducing a living tea plant into Europe, but not until many attempts had failed. The seeds sent to him from China were injured by the long sea-voyage, and so failed to grow when he sowed them; this is just what occurs now frequently; the heat and moisture of the air in passing through the tropics causes seeds to begin to swell, then they are checked by cooler air and dry up. The safest plan for preserving them on a sea-voyage, is to sow them in covered boxes of earth. If it is desirable to keep them from sprouting until they arrive in England, they should be hung up in canvas bags in a

part of the ship where the wind can blow on them. Linnæus, after his failure, was still anxious to have some tea shrubs in the botanic garden at Upsal, in Sweden; so he asked his pupil Osbeck, who became a celebrated traveller and naturalist, and made an expedition to China, to bring him a tea plant if possible. It arrived safe as far as the Cape of Good Hope, where it was washed overboard in a storm. Some time afterwards a captain succeeded in bringing a tea plant into the harbour of Gothenburg, on the south-west coast of Sweden; the evening before landing he left it on the table, and to his great vexation it was eaten by rats. At last, Linnæus advised a captain about to sail for China, to sow some fresh seeds in pots of earth, just before leaving Canton, in order that they might not begin to grow till after passing the tropics. This precaution was successful, and the tea plants came safe to Gothenburg, and were thence transported to the botanic garden, at Upsal, in October 1763. It was not till five years afterwards that some tea plants were brought to England.

The whole history of tea is very remarkable,

and affords some interesting topics of consideration and reflection. In its origin, the shrubs were restricted to one country, and only to a portion of that. The people were by nature most peculiarly capable of the labour of cultivating and preparing it, and this they did for their own numerous population. They were extremely exclusive in their ideas and habits, holding scarcely any intercourse with the rest of the world; and although ranking amongst the earliest in civilization and learning, having in a very remote period advanced far in the path of science, and explored many branches of knowledge, are, even now, very jealous of free mingling with the people of any other nation. They seem to have been in all times exceedingly unwilling to enter into commercial affairs with others, and lived for and amongst themselves. It formed no part of their wisdom to encourage strangers to exchange commodities with them, and yet their fertile land brought forth abundantly and to spare. A very few European ships touched at the port of Canton, and the merchants were not permitted to search for what they might think it profitable to trade in,—they could only buy what the Chinese

chose to offer them for sale. A large portion of the poorer population of the towns situated on the great rivers, or near the sea coast, live on the water entirely in junks, but these vessels are not fitted for long voyages, and very few ever ventured beyond their own territory. The pirates alone formed an exception, and made bold voyages amongst the islands of the Indian Ocean. But, in due course of time, the all-pervading law of exchanging the superabundant produce of one land for that of another for mutual benefit and profit, was extended to the distant and exclusive empire of China in the far-off regions of the East. Chinamen were brought into the ranks of merchants and traffickers in some of the choicest productions of nature. Amongst all these there is probably none which may be reckoned more valuable than tea; and, as one of God's good gifts to men, we cannot doubt but it will be, in the appointed time, dispersed over the world. Gradually this desirable result is approaching; and although tea still grows in a very limited portion of the world, yet there is scarcely any country however remote, where man's skill and enterprise have not conveyed it.

Russia receives tea by an overland route, but to almost every other land it is transported by ships. In Asiatic Russia the poor inhabitants, consisting principally of Mongolian tribes, use what is called "brick tea." This kind is grown in Fokien, a fertile province on the south-east coast of China, where the soil and climate are both very favourable to the culture of tea. It consists of old coarse leaves and damaged stalks, which are all pressed into moulds and dried in an oven. When required for use, a piece of the *brick* must be pounded and kept boiling in water for some time, then salt and milk are added, and sometimes flour, and the whole fried in oil. This is a very different thing from genuine Chinese tea; but it is thought agreeable by the Asiatic Russians, whose taste is not of the most refined nature.

The best water for making tea has always been supposed to be that of rivers; and formerly the Thames water was found to be excellent for the purpose, and it is so still high up the river, above where the tide flows and carries the impurities of London. Even the water of some rivers is perceived to be better for the purpose

than that of others. The Russians have an opinion that their tea is superior to ours; and it was generally supposed to be because their merchants transport it overland from China, instead of its being conveyed in ships by sea, as ours is. An Englishman some years resident in Russia, has lately returned, and informs us that the water of the river Neva is peculiarly excellent for making tea; this is doubtless the reason why the tea made and drunk in Petersburg is esteemed so well-flavoured and pleasant.

The rapid increase in the quantity of tea grown and prepared is one of the most striking facts of the last hundred years, and one for which there is much cause to rejoice. The value of this one plant to the human race is beyond our power to estimate, the amount of refreshment yielded by it unknown and untold; the more it is brought within the reach of the humblest and poorest, the more the comfort and happiness of the lowly home will be increased. Not only does tea afford much wholesome nourishment, but it is able, if sufficiently plentiful and cheap, indirectly,—though surely,—to check the most injurious temptation that the human race is liable

to. Next to England, the Dutch are reckoned the greatest consumers of tea; in the United States of America an immense trade in tea is carried on and no duty paid upon it.

But we must now leave this subject, and give a little time and attention to two others. Here again we may observe the triple union connecting three important things in our minds. Tea, coffee, and chocolate, are the three principal sources of refreshment; let us consider in what respects they differ. If we ask the chemists what is the difference between tea and coffee, they will answer, *none.* Very true, in their estimate of things, for the very same chemical principle exists in both,—they call it *theine;* and they tell us, it is the one cause of the refreshing, strengthening, and nourishing property of both tea and coffee.

We know, however, that the plan and law may be simple, yet the development in form and substance may be varied without end or limit. So we shall find considerable difference in the outward aspect and material of the coffee-tree, as compared with a tea shrub; also in the place of its growth. The coffee-tree grows in Arabia,

in the East and West Indies, and in many hot countries where the temperature never falls below fifty-five degrees of Fahrenheit, and where frost is unknown, that is, where it is never colder than it is usually in England in the month of April. The trees are usually from fifteen to twenty feet high; sometimes they reach a greater height in favourable situations. The stem is slender, and bears slight branches, on which grow large pointed glossy leaves, which are evergreen, not falling off in autumn. At the base of the leaf-stalk spring a cluster of white sweet-scented flowers, which are of extremely short duration; the trees are covered with them two days, and the following they have all vanished. But they have fulfilled their duty, and have prepared the future seed, which is enclosed in a pulpy berry; there are two seeds in each, and they are the valuable portion of the whole tree. As the fruit ripens it changes from green to yellow, red, and dark purple when fully ripe. The oval seeds are flattened on the side where they lie together, and are encased in a tough parchment-like skin; in their natural state the seeds are nauseous and unfit for food, as are many

other productions of Nature. When duly prepared by heat, they afford one of the most refreshing and cheering of drinks, adapted to all climates.

The fertile earth does truly bring forth abundantly a supply of trees, shrubs, herbs, and various kinds of vegetation for the benefit of mankind; but in this instance of coffee seeds, as well as in various others, we perceive the general law to prevail. All things are destined to the service of man; yet he must exercise his skill and labour to bring forth the value of the gifts of Providence. How very few plants are there that grow spontaneously just in the place required by man, or that are fit for his food or clothing, or any other purpose whatever, until some care and labour have been spent on them. Very few vegetables are fit and ready for man's appetite unless first cooked by fire; some are absolutely unwholesome and disagreeable in a raw state. In our country, we have scarcely any plant, excepting watercress and a few that are called salid vegetables, which are eaten raw. In the tropical regions many plants are poisonous before

they have undergone the process of cooking by fire.

The word coffee is derived from the Arabic; for in Arabia it was first known and used. Some ancient Persian manuscripts, in the Imperial Library at Paris, mention the use of coffee in Persia as far back as the year 875. The intercourse between Arabia and Persia doubtless would, at a very early period, convey one of the most valuable articles of the traffic of those times in the East. It was first discovered by Egyptians, growing on the mountains of Yemen, in Arabia, in the thirteenth century; two centuries later it gradually began to be known to the southern countries of Europe. The Arabians were the first cultivators; and the coffee of Mocha, in their country, still retains its celebrity. About 1517 coffee was introduced to Constantinople by Selim, after his conquest of Egypt; but it was forbidden by the Mufti as an intoxicating drink. Now, it is indispensable to all the inhabitants of Turkey, who, not being allowed wine, drink coffee daily. In 1615 Pietro della Valle was sent from Italy to Constantinople to inquire about coffee; and,

by the year 1645, coffee-shops were established generally in Italian towns. They were to be first seen in London in 1652; about 1671, some were opened at Marseilles, in the south of France, when some intercourse was commenced with Turkey. Then they were begun in Paris, on the arrival of the Turkish ambassador, Solomon Aga, in 1669. At first the price in England was exorbitant, as high as four, or even five guineas the pound. In the reign of Charles II., in 1660, a duty of fourpence was set on every gallon of the liquid sold in the coffee-shops which were licensed for the purpose. The first shop of the kind in London was in George Yard, Lombard Street, kept by Pasqua, a Greek, who came to England, as a servant, with a Turkey merchant named Edwards, in 1652. As the use and value of coffee became better known, the cultivation of it naturally increased. Arabia could not supply all the countries whose inhabitants became desirous of obtaining it, when they had acquired a taste for it. But the best coffee is still that grown in the south of Arabia, and imported from Mocha, on the east coast of the Red Sea; it is of a

higher price and quality than any produced in our colonies in the East or West Indies. The coffee of Java is supposed to rank next to that of Mocha. The gradual migration of the coffee shrub to the tropical countries of the East and the West, is a curious page in the history of vegetable life, and worthy of remark, also, as showing how Europe, the smallest so-called quarter of the world, bore an important part in the work which was to prove of universal advantage. In those days it was the same as it is now; European skill and science are ever called to aid in the great objects which occupy the attention of mankind and are intended for the general benefit of the human race. Europe is the centre of the world, civilized and uncivilized, in one sense, though not so apparently important, from its geographical position; and we find in the history of man, and his countless interests in all regions, that it must perform its destined part in the advancement of every good undertaking.

About the year 1690, Van Hoorn, governor of the Dutch possessions in the Indian Ocean, obtained some coffee seeds from Mocha, and

raised several plants from them in the island of Java, whence he sent one to his friend Nicholas Witsen, a burgomaster of Amsterdam, and governor of the Dutch East India Company. This coffee plant was placed in the conservatory of the botanic garden of Amsterdam, and notwithstanding its northern situation, it flourished and bore flowers and fruit. As soon as young plants were raised from the seeds, some were sent to Surinam, a Dutch settlement on the north-east coast of South America. In 1718 the colonists there began to form coffee plantations. The Dutch had now established a thriving colony at Batavia, on the north-west coast of Java, and in 1714, sent a present of a coffee tree to Louis XIV., king of France at that time. Some years afterwards he was induced to forward some offsets of this tree to his province of Cayenne, a territory adjoining the Dutch province of Surinam. Thence it was taken, in course of time, by European settlers, to Martinique, one of the West Indian islands belonging to the French. The advantages arising from the cultivation of coffee now spread rapidly throughout the West Indies. In 1728 the

governor of Jamaica introduced the new shrub to the estate of Temple Hall, in the district of Liguanea; and, in the space of four years, the coffee plantations were so much increased, and their produce become of sufficient importance to attract the notice of the legislature of the island; and an act of council was passed to encourage the growth of coffee. In 1752 Jamaica already exported sixty thousand pounds weight of coffee; in twenty-four years more, the quantity was augmented to four hundred and forty thousand pounds.

The mountain districts and even the level parts of Jamaica, are favourable to the growth of coffee; on the driest spots the trees have frequently yielded abundant crops. In cooler, shaded, and consequently moist situations, the quantity of fruit is often so great that the branches must be supported to bear the weight. The annual produce of a tree varies extremely. They usually bear fruit at two years, but the full supply is not till the tree is four or five years old; then, a full grown tree yields from two to seven pounds of seeds in a year. The trees suffer from the attacks of rats, flies, and

caterpillars, and require much watchful care, during the first year of their existence especially. Hurricanes, also, frequently damage the trees, the stems and branches being of a slender size, and of necessity allowed freedom of growth; if they were pruned like many kinds of fruit trees, they would not bear plentiful crops. It is usual to plant other trees between the rows of coffee, to shade them from the scorching heat of the sun. The appearance of the plantations when the white flowers are on the trees is most exquisite. In the East Indies we shall find that coffee-trees have multiplied in a striking degree, as in the West Indies. The plantations of Malabar yield coffee nearly, if not quite, equal to the best quality; in other parts of that extensive country it also flourishes well. On the Himalaya mountains it thrives at an elevation of three thousand feet; and, doubtless, many localities exist on the lower range well adapted to the cultivation of coffee. The coffee plantations of Ceylon have become, within the last twenty years, of great value, and afford a very profitable object of cultivation and of trade. From several English seaports ships now depart

at regular times, constantly employed in the coffee trade with Ceylon. There, as elsewhere, Englishmen own the plantations, and employ native labourers to attend to them. The Arabians, who were the first cultivators of coffee, and very careful in their management of the trees, make the chief gathering in May; to insure only ripe fruit being taken, the gatherers spread cloths under the trees and shake the branches, by which means all the berries that are fit fall down. They are then collected in bags, and carried into a building open at the sides to the air, where they are laid out on mats to dry. When this is thoroughly accomplished, the berries are crushed under heavy cylinders to break the shells and separate the seeds from their tough case. Afterwards they are winnowed and dried in the sun before being packed for exportation. In the West Indies the negroes hang a bag, or. basket, with a ring at the top to keep it open, round their necks; and then gather the berries with the greatest care, in order to prevent injuring the unripe fruit left for future gathering. An industrious negro will collect about three bushels in a day, which

quantity yields about thirty pounds of coffee ready for sale. The pulp is fermented and a spirit distilled from it, esteemed in Arabia. In a raw state the seeds have no sign of the peculiar properties they possess; but when roasted in vessels prepared for the purpose, a great change takes place. An oil exudes from them, during the process, which thickens, like butter, as it grows cold. Coffee should not be ground until required for use, lest the oily particles should be dried up, or escape. The aromatic and bitter principles are developed by the after process of boiling. The best method of which is said to be, to put a pint of cold water on two ounces of ground coffee; when it boils, pour off the liquid, separate for a time, and then add a pint of boiling water and keep the coffee boiling on the fire for three minutes; pour it off clear on the first portion, and it will be ready for use. By this way of preparation, the aromatic and bitter properties are best developed and preserved, the flavour also is fine and retained in the greatest perfection, and the coffee is of the most refreshing nature. The leaves are said to contain nearly similar qualities to the seeds, and

are dried and used as an infusion in Java, in the same manner as tea. Animals, particularly goats, eat the leaves in Arabia.

Throughout the whole continent of Europe coffee is one of the most general of beverages, —nourishing and exhilarating; twenty-five years ago it was reckoned that one hundred and twenty millions of pounds were annually consumed in Europe, and a fourth part of the whole quantity was used in France. During the last twenty years the consumption of coffee in England has increased exceedingly, and is still increasing as the supply becomes more plentiful, the duty diminished, and the cost to the purchaser consequently less.

The custom of making a kind of coffee from chicory, in France, has been unfortunately adopted here, and led to a vast amount of deception and adulteration. Chicory itself is not unwholesome, although much less invigorating than coffee, and it is liable to great deception, for it is made into cakes, and it is impossible to perceive what false substances may be added to the true root. It is much to be desired that every family had a small coffee mill, and could

thus buy whole coffee seeds, especially the poor working-classes, who want the greatest portion of nourishment possible in whatever food they can afford to buy. We would gladly look forward to the time when the industrious poor shall be able to refresh themselves with genuine coffee from the tropics, at so moderate a price that none need be deprived of it. And, moreover, let us all unite in the sincere wish that all may not only be able, but desirous to profit by it, and not be induced to take stronger but far less nourishing and invigorating drinks, which, instead of cheering the heart, stupify it, and leave a man more weary and worn, than he would be after the hardest labour, or the scantiest supply of food. We must not forget the last of the three valuable plants, which we proposed to consider in this chapter. I will now tell you something about chocolate, or cocoa, for by both names the trees are known.

The tree grows naturally in the tropical countries of America, that is, the regions of what is usually called Central America, including the isthmus which connects the two continents and a portion of North and South America.

When the Spaniards first entered and conquered Mexico, they found the *cacao* to be almost the only object of regular and careful cultivation by Mexicans; the produce being reckoned by them one of the chief treasures of their country. The cacao-tree seldom rises above twenty feet; it has a smooth, grey bark; the leaves are large, oval, and pointed; the flowers are small, spring forth in clusters from the main stem and the branches, are of a pale pink and buff colour. Many flowers fall off unproductive; seldom more than one or two fruits ripen from one cluster of flowers. At first the fruit is green, but when fully grown, it becomes purple and red brown in ripening; it is of oval shape, six or seven inches long, contains from twenty to thirty seeds placed in rows of five compartments each. The soft pulpy substance of the exterior part which surrounds the seeds is rather acid, but pleasant to the taste. The native Mexicans eat it with sugar. The savage tribes of the country eat the pulp and cast away the seeds, not caring to convert them into chocolate. The traveller Humboldt relates that he often found heaps of the seeds lying on the ground

where they had been encamped. This is one of the many instances which prove that uncivilized men cannot avail themselves duly even of the most common and abundant gifts of the earth which surround them for food, the first necessary of life. As it was in the beginning of creation, so it is now, the earth brings forth abundantly trees yielding fruit,—as a garden, but man must be therein "to dress it and to keep it," and by diligence and skill make all things subservient to his use and benefit. In Mexico the seeds are used as money, six of them being equal to an English halfpenny. The smallest coin is twelve sous, or sixpence; therefore it is very convenient to employ these seeds thus in small change. Since the extensive working of the mines both of gold and silver, the cultivation of cocoa-trees has been gradually neglected by Spanish settlers, and at the present time the chief supply of cocoa and chocolate for Mexico is derived from plantations in Guatemala, a fertile province on the isthmus which connects North and South America, a country formerly despised by the Spanish settlers because it contained no gold or

silver mines. But those who preferred the cultivation of the surface of the land, and formed chocolate plantations, acquired in time more real and substantial wealth than from the mines of Mexico. The cultivation afterwards spread southwards in South America and afterwards into the West India Islands. In Trinidad, Grenada, and St. Lucia, the English colonists now grow chocolate, and it has of late years become a valuable article of commerce. It requires very few labourers to attend to a cocoa plantation, and no expensive machinery to prepare it, as in the case of sugar. The principal disadvantage is that some years elapse before the trees bear fruit, but though slow it is a sure return at last. It is said that in Mexico a peasant's family forms a cocoa plantation around the dwelling, one slave suffices to assist in the labour required, first in cleansing the soil, then planting some bananas, under the shade of which the young chocolate plants must be sheltered during the first years of their growth. They are liable to the attacks of caterpillars and other insects which must be carefully destroyed. Parrots also are great

devourers of the pulpy part of the fruit, and frequently injure more even than they consume. But notwithstanding all these risks and liability to danger, the chocolate cultivation is extremely profitable; it is reckoned that a plantation of thirty thousand trees will ensure ample wealth to a family for more than one generation. When once it is full-grown, and the trees produce their plentiful crops of fruit, the planter may enjoy in peace the possession he has formed. The stems are deprived of branches and leaves to about ten feet from the ground, affording a delightful shaded walk, and the long rows of productive trees form an exceedingly pleasing prospect. The two chief seasons of gathering are June and December. Then a negro passes along with a forked wooden stick; with this he detaches the ripe fruit, and another negro gathers them into heaps, whence they are carried to the shed where the seeds are separated from the pulp. This is done by women and infirm negroes; the fruit is cut open with a knife, and the seeds taken out with a wooden spoon; the seeds, still enclosed in a portion of the pulp, are then thrown into holes

and covered with fine sand; in this state a slight fermentation comes on, fresh layers of sand are put from time to time to absorb the moisture which is developed; this requires the superintendence of an intelligent overseer. The seeds are afterwards spread in layers in mats in the sun, to be perfectly dried before being packed for exportation. This usually takes place soon; for if kept long in the heat of a tropical climate, insects would very probably destroy or injure them. The seeds are about an inch long, some varieties wider than others. The husk is rather paler than the kernel, and does not adhere to it. These when detached are used for making a kind of drink of less richness than what is made from kernels, and more agreeable to some persons. Sometimes the cocoa is packed in bags made of buffalo hides containing about a hundred weight each. The quantity imported to all parts of America and Europe is enormous, and yearly increasing. The preparation of cocoa or chocolate was long unknown to Europe; it was an art entirely confined to Mexico, and the whole supply was sent out in a manufactured state. The con-

sumption was very great; it formed the principal support of all classes; before sugar was known in the country, honey was used as an ingredient to qualify the bitter flavour of the seeds. Some of the Spanish nuns who were established in Mexico were very clever in preparing chocolate, and invented the plan of mixing pimento, vanilla, and cinnamon with it, thus rendering it still more agreeable to the palate. When at length the unprepared seeds were imported into Spain, the manufacture of chocolate was established in that country, and speedily gained high favour amongst the Spaniards at home, as well as with those who had colonized in Mexico. The first process after careful cleansing is to roast the seeds in the same manner as coffee. They are then winnowed to separate the husks; the pure kernels are again roasted to heighten the aromatic flavour, and afterwards crushed by a roller over a smooth stone, till the whole becomes a fine powder. Sugar and spice are added with a little cold water, and the whole compounded into the state ready to be packed in tins for exportation or use. In different countries the manufacture is now carried on, and different

plans used according to the tastes of the people. In France sugar is used, and vanilla, in the composition; but in Mexico, although the vanilla grows naturally, it is not used, being thought injurious to the nerves. In Germany, the husks are separated by immersing the seeds in boiling water; and the kernels, when cold, are crushed in wooden mortars, and neither spice nor sugar is added until the time of using. In Ireland, Belgium, and Switzerland, and in the United States of America, they form a considerable article of commerce. Broma is another kind of composition made from chocolate seeds; and as it is closely compressed in packets is very convenient for travellers, containing a large portion of nourishment in a very small space. It has been remarked, that the various preparations of chocolate and cocoa have enabled travellers to explore many hitherto unknown regions of the world, where no large packages of food could possibly have been carried, and where, for this reason alone, no long journey in a wild country could have been undertaken.

The small packets of condensed nourishment in the form of chocolate cakes, cocoa paste, or

broma, have been the means of furnishing a supply of food to numerous enterprising travellers, to whom we are indebted for the filling up of many vacant spaces in our maps, as well as for the additional knowledge of many new objects of interest on the globe; and for countless sources of valuable information towards an accurate and right appreciation of the endless treasures of the earth.

CHAPTER XI.

ON HEMP, FLAX, AND COTTON.

We have already considered the nature and structure of plants in general, and have perceived many remarkable points in their formation, some of which are obviously of importance to the well-being of the plant itself, and assist essentially in the work of growth and perfection of its nature. There are other curious facts in the structure of plants on which their value to man chiefly rests, and this is not only in the outward form and substance, but in the internal arrangement of the very material of which the plant is composed. The more we search into these hidden things, the more clearly are we enabled to perceive that all things are destined to the use of man; else why are such countless proofs of the merciful care of the Creator continually unfolding themselves to our senses. I have reminded you of the threefold value of plants to us; from the beginning of time they have yielded to man the three chief materials

required by him in this world,—food, clothing, and dwellings. We have discovered a few interesting particulars concerning those which yield us food, and find, on examination, that by far the greater portion of nourishment consumed by all living beings is derived from the vegetable race. We will now think of those plants which supply us with clothing; in this department also they are extremely valuable, although some materials for our garments are afforded by animals, and no doubt the first inhabitants of the earth were clothed almost entirely in the skins of animals; afterwards they learned how to spin and weave wool, and made cloth for wear. The first vegetable substance which was converted into clothing material is believed to be the fibrous part of a plant called flax. This is one of our native plants, often found growing wild in natural pastures or cornfields; the stalk is very slender, about two feet high, and has small pointed leaves placed alternately on the stem. It bears exceedingly delicate pale blue flowers of five petals, with five points to the green calyx, which forms the outer circle. In the centre are five stamens with

their powder-cases, surrounding the future seed-vessel surmounted by five small columns. The fragile blossoms soon fade and fall away, then the seed-vessels enlarge and become round, the five cells of which each is composed being firmly united together until the seeds are ripe.

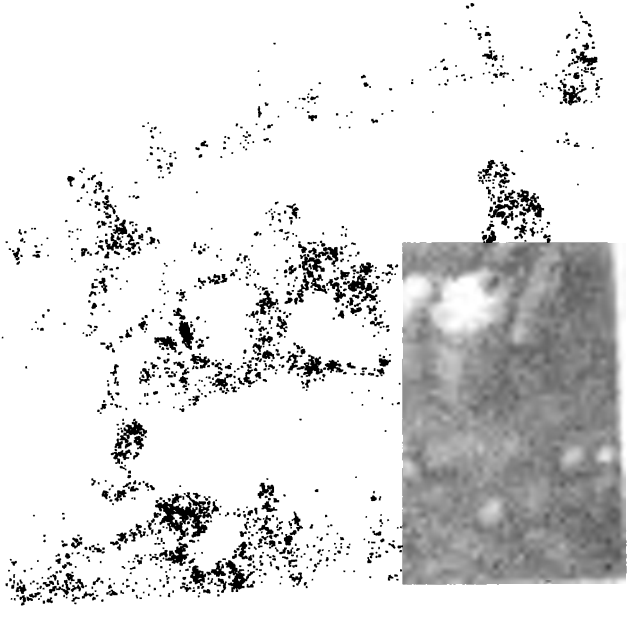
When flax is sown in a field, and the whole crop is in flower, it is one of the most graceful that can be seen; the stems, although very slender, are extremely strong, and the effect is light and beautiful both in form and colour. It seems to thrive best in a moist situation and damp climate, and is therefore now successfully cultivated in Ireland, particularly in the north, near Belfast. In Lancashire, also, flax is becoming a general crop, and is found very profitable to the farmer. The seeds are sown in March, and the plants, when the seeds are ripe in autumn, are pulled up by the roots; if the object be to save the seeds, they are spread in the sun to dry; but if the fibrous part be the chief object, the plants are tied up in bundles, and laid to soak in pools or ponds of water. By this means the pulpy part of the stalks dissolves and the fibres are loosened. The bundles

are then taken out, and spread in a dry sunny place till the stalks are quite brittle, and the fibrous flax is easily separated by beating from the rest of the plant.

Flax is grown abundantly in several countries of Europe. In Russia a vast quantity has been cultivated and exported for many years; until we began to attend to this branch of cultivation in Great Britain about fifteen years ago, we were chiefly dependent on Russian supplies of flax. The advantage to Ireland is already proving very decided; for the increase of employment which it has brought to poor labourers, and also the suitable work which it affords to children in the factories at Belfast, has considerably diminished the beggary and misery that formerly prevailed there to a sad degree. It was one of the common crops of England as long ago as in the reign of Henry VIII., for he passed an Act of Parliament to forbid the soaking of flax in streams or ponds where persons or cattle were accustomed to drink the water. It was supposed that during the time fermentation was going on and a very disagreeable smell arises, that the water was thereby rendered unwhole-

some. When the plants are grown for the sake of the seeds, they are first well dried, and then pulled through the long teeth of a kind of comb; this separates the seeds, and they are afterwards sifted and cleansed from the dry parts of the seed-vessels. The oil yielded by the seeds on being pressed is of much use for various purposes, both in medicine and in painting and varnishing. It is also sometimes employed in making a particular kind of soap. The remaining farinaceous portion of the seeds, after the oil has been pressed out, is called *oil-cake*, and serves as an excellent fodder for fattening cattle. If you were to see the fibres of flax in their first state, you would scarcely believe that they could ever be converted into the delicate material called cambric; but such is the power given to man, that no change seems to be too great to be effected by skill and perseverance, in this way of bringing all material substances, especially those derived from plants, into use.

In very ancient times the art of spinning and weaving flax was discovered, and linen made of it was evidently highly esteemed, for it was used



some. When the plants are grown for the

for the best purposes. We read in the book of Exodus, that when the Israelites were come safe out of Egypt, and were preparing the Tabernacle, some of the curtains for it were to be made of linen, and "all the women that were wise-hearted did spin with their hands, and brought that which they had spun, both of blue, and of purple, and of scarlet, and of *fine linen*;" also some of the sacred garments for Aaron, and after him for all priests, were made of "fine twined linen." Therefore we know that the art of making fine linen out of flax fibres has been known and practised in the world for more than four thousand years. Linen was esteemed above woollen cloth in the East and in Palestine, and is mentioned several times in the Scriptures as an indication of the rank of the wearer. In the parable of the rich man and Lazarus, we are told only two things about the outward state of the rich man, and they relate to his clothing and his food. He "was clothed in purple and fine linen;" that is quite sufficient to inform us of his riches, even if it were not added that "he fared sumptuously every day;" for the woollen cloth dyed purple

was very rare and costly, only worn by kings and great persons, and the "fine linen" was the most choice and expensive material, to be obtained only by the rich. Again, when Joseph of Arimathea, an honourable counsellor, came and begged the body of Jesus, "he brought fine linen, and took him down, and wrapped him in the linen, and laid him in a sepulchre." Then, when angels are described to us, we are simply told that they are "clothed in pure white linen." This suggests to our minds the desired idea; we know what it is intended to represent to us. At least we may know, if we study careful the nature and history of fine linen, how it is brought to its state of fineness of texture and purity of hue. It was not by nature fine or white, but it is rendered so by a slow and careful process of purification, cleansing, beating, bruising, being long exposed to a scorching sun, and then at last spun and woven into a new substance, so far superior to its original condition that no one could recognise it as having any connection with the little humble green herb springing out of the earth. How this helps us to comprehend the meaning of that

short but beautiful description of the "great multitude before the throne, clothed with white robes." No better earthly type could have been selected to explain the heavenly vision of St. John, in all its significance, to our understanding.

Linen was in the earliest period of civilization the most delicate material for garments. The ancient Egyptians were acquainted with the art of spinning and weaving flax in the time of their greatest prosperity, more than two thousand years ago. Linen cloth was not only used for garments by kings and rich subjects in their lifetime, but the mummies found in the royal tombs of the pyramids at Thebes were wrapped in fine linen. Flax requires a considerable supply of water during part of the time of its growth. The lands within reach of the annual inundation of the Nile were peculiarly favourable to it, and, doubtless, furnished the chief supply to the country. Herodotus, who received the title of the "Father of history," because he is the oldest Greek historian whose authentic historical writings have been preserved to us, was born four hundred and eighty-four years

before the time of Christ. He travelled in Egypt, and he tells of many things which he saw and observed there; amongst other remarks, he noticed that the Egyptians "were very regardful of neatness, and wore linen garments." It does not appear that flax was carried into India with other products of Egypt, nor that linen was taken there in very early ages, probably because of their already having cotton, which was more available to the Hindoos, and better adapted to the heat of the climate.

At the present day, cotton calico, or longcloth, is generally worn throughout the East Indies, in preference to linen cloth. The flax now cultivated there is entirely for the seeds, which are valued for their mucilaginous qualities as medicine, and for the oil in various ways; the rest of the plant is thrown away unheeded. As flax is amongst our native plants, we know that it likes a temperate climate; therefore, are not surprised to find that it is grown on the plains of India only during the cold months, and after the rains have begun. In North America flax is extensively cultivated, and a great deal of

the seed, commonly called linseed, is sent to England.

I have said that it frequently occurs that some peculiar arrangement of the internal structure of a plant causes a great effect in its value or use to man, and an invisible difference may be of much importance. There is an example of this in the flax plant; few persons know the fact by having seen it, but all persons who use linen, or cut out garments of the material, are aware of a peculiar character in its texture, that it cannot be torn or rent by the hand until it be much worn. But new, strong, cotton calico, can be readily rent, when a small notch is first made. Every one who uses a cotton umbrella must have remarked the very long time it requires in drying after being exposed to rain, much longer than one of linen or silk. These are common facts of common daily life, which all may know by experience to be true, yet few know further; nor could any one know the reason of this and many other occurrences within our observation, had not the studies of the wise and scientific men who devote themselves to such pursuits, and make use of the

means which modern intelligence, aided by improved microscopes, afford,—explored the secrets of nature's works, and laid them open to scholars of all ranks and ages.

Now that so much is revealed to us, let us not keep our eyes closed, but diligently search into these things, and seek for a more exact knowledge of such objects as are constantly around us, contributing essentially to our comfort; and the more so, the more we really know their structure, their capabilities, and their fitness to different uses. What, then, is the difference between the internal structure of flax and cotton? The fibrous vessels of the two plants are of two kinds; those of flax are fibrous thick-sided cylinders jointed like a cane, grouped in bundles, neither flattened nor spirally twisted. The fibres of cotton are from a different portion of the plant, and are of a different formation; they are flattened tubes of cellular tissue, without joints, entirely distinct from each other, and are twisted spirally. This causes the difference in rending, and also in drying. The jointed fibres of flax are stronger than the flattened fibres of cotton, and moisture cannot escape so

easily from the flat vessels of cotton as it is able to do from the hollow fibrous vessels of flax. For the same reason, garments made of cotton are warmer than those made of linen; they retain the warm air longer. You may never have an opportunity of looking through a large microscope and beholding these curious facts yourselves, but you can believe the results of the researches of others; for remember, in this as in far higher and more important subjects, we must "walk by faith, not by sight." The chief textures manufactured from flax are strong linen of different qualities of fineness; the coarser and stronger kinds are used for sheeting, the finer for shirts and such garments. Lawn is a still finer material, and is used for clerical robes; the thinnest sort for bishop's sleeves. The finest flax texture is cambric, so named because it was first manufactured in the town of Cambrai, in the north of France. There are still extensive manufactories there, employing a vast number of workers. Although so clean and delicate a material, it is not a healthy occupation to attend to the weaving of it. The excessively fine thread of which cambric is made

is so fragile, so like a spider's web, that it could not be spun at all in a dry hot air; therefore, the work is carried on in cellars, where it is so damp and unwholesome that the poor women who attend the machines suffer extremely from rheumatism, and can only work at them for a few years. Cambric is made of various degrees of fineness; some strong and close, some so thin and transparent as to resemble muslin.

In the great Exhibition of the Industry of all Nations, in Hyde Park, London, in 1851, there were shown some very elegant dresses made of fine, thin, flax material, printed in coloured patterns like the usual cotton muslins; the foundation was of a pure white, as all linen is, which displayed the patterns remarkably well. The texture was also extremely smooth on the surface, which would be very agreeable in the hot summer season. Probably, however, there was some reason which prevented this new invention from becoming generally patronized, for the pretty linen muslins have never appeared in public or private life since.

You have now learned something about flax and linen, and, I hope, enough to make you

wish to know more, for there are still further observations to be made on this subject. I would rather leave some of them for you to search out for yourselves; but I should like to ask you just one question before we conclude this part of the chapter. Can you discover any reason why *linen rag* is so desirable for binding up wounds? Why is it better than that of *cotton calico?* Everybody who has had anything to do with the care of the sick knows that linen is preferred for that purpose, and what collections of old linen are made in time of war. After the battle of Waterloo, now forty-five years ago, linen rag was sent from all parts of England to London, that it might be forwarded to Brussels for our wounded soldiers. And during the late war in the Crimea, what gatherings of old linen were made in almost every household throughout the country, and despatched to the hospitals in the East to bind up wounds. The reason is simple and plain; the fibres of flax are straight and smooth, having no hairs on their surface; therefore, when the material is worn, and has been washed often, it becomes very soft, and also cool in texture; it

is not heating for bandages, and it has no fine loose particles to adhere to the open parts of a wound, to cause pain in removing, and prevent the healing. The fibres of which cotton is spun and woven belong to a very different part of the plant, and are of a different nature, as we shall perceive presently. The last use made of worn-out linen rag is to make the best white paper.

Now we will consider another vegetable material which yields spinning fibres, and consequently is made into cloth. There is one group of plants put together on account of their all having strong fibres, capable of being twisted into cords and threads, and so woven into cloth. We always like to learn some old account of anything we value in the present day; if it is useful to us, we naturally wish to know whether the people who lived long ago in the old times had any benefit from it. So let us apply again to the "father of history;" perhaps Herodotus knew some particulars of a plant we call hemp, belonging to the same tribe as our common stinging nettles, but infinitely more valuable. When he travelled in Thrace, the country now

called Turkey and inhabited by Turks, he found the ancient Thracians wearing a strong cloth, which they made from the fibres of a plant growing there, and called by nearly the same name as it is now in Latin. Hemp is a native of many countries in the East; and there is no doubt it was early known and esteemed for its tough strong fibres. The cloth made from it was well adapted to people who spent their chief time in hunting or in war; for it is remarkably strong and warm, and can endure much longer wear than that made of flax or cotton. Hemp was known to the Arabians in the most remote period, and the name is derived from them. It does not grow naturally in England, but was formerly cultivated in Norfolk and other south-eastern counties. Our ancestors had it spun and woven for domestic purposes; and the good old housewives of past times were never without a good store of hempen sheets, towels, and all kinds of household cloths, in their oak cupboards. Now it is seldom seen in England, except for very common purposes; though in Germany many old fashioned families still prefer it to any other

kind of material; and in remote village inns there is always a plentiful stock of hemp linen. It requires a rich soil and moist situation. In France it is one of the first novel crops that meets the eye of an English traveller, as he passes through Picardy on the road to Paris. Then, again, on the banks of the Loire, in the month of September, he will observe on the dry sandbanks of the river a quantity of dry brown stalks, tied in bundles, and set up in sheaves to dry in the sun; that is hemp, and a valuable crop of the country.

But what is the appearance of the plant when growing in the fields? It has a firm slender stem, from six to sixteen feet high, according to the heat and moisture of the climate. The leaves are placed opposite each other on the stem, divided into five slender parts, notched at the edges. At the top of the stalk is a spike of small green flowers, drooping at their short stalks; some have no seed, others one. A useful oil is extracted from the seeds, which is employed here in painting, for feeding birds in cages, for poultry, and other purposes. The Russians use it in cookery; also for lamps, for

which it is well adapted, being very clear and without smell. Hemp is cultivated to a great extent in Russia, and furnishes an excellent supply of cordage material, as well as canvas for sails, and a strong coarse cloth for the use of the peasants. Many European plants, that could not thrive on the plains of tropical countries, are able to find a suitable locality and temperature on mountains. Thus hemp is only cultivated in very small quantities near villages on the plains of India, for the sake of the leaves, which they use like tobacco, and a kind of resinous substance which oozes from the upper part of the plant. On the Himalaya mountains hemp is extremely abundant at an elevation of six thousand or even seven thousand feet, growing to ten or twelve feet in the stalk. The hill people employ it for coarse sackcloth, and for strong ropes, with which they make bridges to cross the mountain streams. In Bengal the natives value hemp chiefly for the purpose of making from it a strong liquor, which, from certain narcotic properties in the plant, is very stimulating.

The East Indies, the Philippine Islands, Italy,

and Russia, all contribute largely to the supply of hemp to the world. The port of Riga, on the Baltic Sea, sends away many shiploads of hemp, in the course of a year. A great deal of hemp is grown in the interior of Russia beyond Moscow; and the cultivation, drying and sorting the different qualities, forms an important occupation. The hemp merchants are rich men in Petersburg, and give great attention to the trade; two immense warehouses are devoted to the stores of it, and all that can be spared is sent away in ships, chiefly American. They are careful only to bring it out in fine, dry weather; for if it should be wetted with rain, it would ferment and decay during the voyage. In this country hemp is not so much used for wearing garments as it used to be; but in the agricultural districts it is the common material for labourers' frocks. One of the strong household cloths made of it, is called *huckaback*, and was the usual article for table linen before cotton became so generally employed. Although the fibres undergo a long bleaching process before they are spun, or woven, yet the texture is of a brown hue when

compiete, and gradually whitens with washing and wear. The separation of the fibrous part of the stalks is effected nearly in the same manner as that of flax,—soaking, drying, beating, and drawing through instruments called *hackles*, like coarse combs. Thus prepared in the rough state, it is called tow; afterwards, it is spun into thread, which is made into twine, cord, ropes, cables, and every possible article of the kind. It is also woven into various sorts of texture, from a fine quality to the strong canvas used for the sails of ships, and a less substantial coarse material for sacks.

In the early part of this century, many impediments came in the way of our receiving the usual supply of hemp from Russia, and this seemed to cause attention to be turned to the subject of cables for ships; they were so essential to our national existence, that ingenuity and invention strove to discover some other plan, and it was about 1810 than iron chain cables began to be used for the anchors of ships. This shows that some pressing necessity is often wanted to bring forth into practice a

good idea or suggestion. Forty years before that time, a celebrated French navigator suffered great dangers on a voyage of discovery round the world, in an unknown sea,—losing six anchors in nine days, from the hempen cables breaking. He narrowly escaped shipwreck; and on his return home, he said, if they had only been supplied with iron chains for the anchor, they should not have been in such peril. It does seem strange, certainly, that they should not have been adopted long before, as we were well experienced in all kinds of iron work; and it was obvious, that rocks and coral formations in the sea must be very liable to wear and cut a hempen cable, whilst a ship is at anchor in rough, or even calm weather.

But we are now more directly considering the plants which yield us clothing materials; and as we are no longer almost entirely indebted to hemp, as our ancestors were, let us pass on to a more modern material now in general use. Cotton is one of the most useful productions of vegetation. I only call it modern in regard to our use of it, and its present perfection of texture and abundance; for in the natural state,

and also simply spun and woven by the hand, it is one of the most ancient of vegetable substances used for spinning in the East. India is its original country; and, in all probability, it spread thence into Egypt and all parts of the Old World. Herodotus, who is the faithful recorder of such facts, describes the Indians, and relates what he observed of their manners and customs; amongst other things, he says, that "they possess a kind of plant which, instead of fruit, produces wool of a finer and better quality than that of sheep; of this the natives make their clothes." This was evidently cotton wool. It is probable that, in course of time, cotton seeds were sent into Egypt with cinnamon, frankincense, and other productions of India; for Pliny, the Roman naturalist, who wrote his book five hundred years after Herodotus, mentions, that in the part of Egypt towards Arabia, there grew a small shrub bearing a fruit, from the interior of which a kind of wool was produced, from which clothes were manufactured, inferior to none in softness of texture and whiteness of hue, therefore much prized by the Egyptian priests. We

may at the present time consider cotton to be one of the most precious things we derive from vegetation for clothing material; for it not only has been transplanted into all the countries where the climate is favourable to its growth, but it is conveyed to all parts of the world, either in a raw or manufactured state. Some kind of texture, woven of cotton, forms a part of the garments of a very large portion of the human race, being remarkably well adapted for warmth in cold countries, and for lightness in hot climates. The plentiful supply of it renders it most valuable to us; and the first means of leading savage nations to adopt the customs of civilized life, is to induce them to take bright-coloured cotton cloth in exchange for ivory, gold-dust, bees-wax, nutmegs, palm-oil, or whatever else they may have. When Rajah Brooke first began to gather the young Dyak children at Sarawak into a school, they were supplied with neat coloured cotton garments. There is no other material that can in any way supply the place of cotton.

Let us see what kind of a plant it is in appearance and manner of growth. It is gene-

rally about two feet high, having leaves on stalks placed alternately on the stem, divided in five deep notches. The flowers have five bright yellow petals, with a dark red spot at the base of each. The stamens are united together, and form a column around the future seed-vessel. The petals fall off soon, the green calyx remains below the seed vessel, which bursts open into five parts when ripe. The numerous dark, hairy seeds are then seen in the midst of the mass of white cotton. The plants are not suited for a cool climate, and only one kind can grow in the open air, so far north as the southern parts of Europe, on the shores of the Mediterranean Sea

Although cotton was originally only indigenous in the East Indies and in South America, it is now cultivated over a wide range of the earth's surface, on both sides of the equator: northwards, it extends to south Europe, on the south to the Cape of Good Hope. It is cultivated all over India, in Ceylon, in the islands of Java, Timor, and others in the Indian Ocean in the peninsula of Malay, in Burmah, Siam, and China. For some years the islands and

shores of the Mediterranean supplied France with cotton. All parts of North and South America now possess abundant districts of cotton; in Peru, it appears to have been known in very ancient times. It is often associated with the sugar-cane, for the same kind of climate is favourable to both. On the Andes of South America, cotton grows as high up as nine thousand feet; on the mountains of Mexico, also, it flourishes. Some kinds of cotton appear to be benefited by a vicinity to the sea, and much depends on the moisture or dryness of the air, as well as careful attention to the cultivation of the plants. In some situations, plants are more liable to produce leaves, in others flowers; with the cotton plants it is naturally desirable to have as many flowers to furnish the valuable seed-vessels as possible; therefore, those who attend to the cultivation check the growth of leaf-buds, which tends to increase those of flowers. It does not require a rich soil, but will grow where many other crops would not flourish. The seeds are sown in holes made in regular rows. In China a sandy soil is most favourable for cotton; the margins of rivers which are over-

flowed in floods, or on the melting of snow, and thus acquire a deposit of mud, are also very good cotton grounds.

The Chinese being amongst the earliest of civilized nations, and cotton being a native plant of China, we might expect to find them acquainted with cotton and its use in remote times. But these ingenious people did not discover its value until a late period in the history of their empire. We find it recorded as a historical fact, that in the year 502 of the Christian era, when their series of emperors was already a long one, the reigning emperor, Oule, was possessed of a *cotton robe*. In 700 we find that cotton was grown in the imperial garden of Pekin, but only as an ornamental plant; not till the year 1000 do we read that cotton was grown in fields for useful purposes. Very slowly did its value become appreciated by the Chinese; nearly three hundred years passed by before it was generally cultivated throughout the empire. Nothing proves more clearly the value of cotton cloth for garments than the fact, that when it was once known and dispersed amongst the Chinese (the most preju-

diced people in the world), it was adopted as a general article of clothing by the immense population of that vast country. Although cotton is now grown in large quantities in all parts of China, yet they are obliged to import a considerable supply from India. It is said that nearly forty millions of pounds are yearly transported by sea from Bombay to Canton. One kind of cotton grown in China produces wool of a buff or yellow colour, known as Nankin; now not much used in this country, but formerly very frequently employed for children's dresses, for which it is very suitable, being remarkably strong as well as warm. Cotton is now cultivated over the whole of the vast territory of India in British possession stretching from eight to thirty-one degrees of north latitude. On certain portions of the Himalaya mountains, cotton has been found at an elevation of four thousand feet, especially in the tract between the Ganges and Jumna rivers, between twenty-eight and thirty-one degrees. The cultivation of it there is not extensive; for the poor untaught natives of the hill countries care only for sufficient means of subsistence and

clothing for themselves, having no ideas of superabundance for the sake of trade with other people. A small cotton-field is usually seen around their humble dwellings, and the produce is spun and used by the women for their own families. It is said that the cotton in the district of Kemaon is remarkable for its softness and excellence. That of Dacca, once the capital of Bengal, to the north-east of Calcutta, on a branch of the Ganges river, is one of the best cottons of India, and from it is made the fine, delicate, Indian muslin, about forty years ago considered a very beautiful material for the best dresses of English ladies, before our own manufactures were risen to such perfection as they have now acquired, and when a taste for simplicity in dress prevailed. The longcloth of Madras has long had a high reputation, and was extensively used here by all who had any intercourse with India, before our weaving machines for calico were improved. There is a town called Calicut, on the coast of Malabar, which gives its name to one kind of cotton cloth, *calico*. There it was, until the last twenty years, spun with an old distaff by native women,

and then woven by poor Hindoo weavers. There they sat, each at his primitive kind of loom, placed under the shade of a spreading tree, content to work on, daily weaving strong, good, cotton cloth; requiring only a little boiled rice for food. The cost of a mile length of cotton thread, thus spun by native women, was fourpence, and that rate of payment barely sufficed for the maintenance of even an abstemious Hindoo. The cotton machines of Manchester have now entirely superseded the labours of the poor Hindoo spinners and weavers, except in the solitary villages far away amidst the mountains. The cotton wool can be brought half across the globe to England, manufactured at Manchester, and carried back again to India, and there sold at a less cost than when bought of the native weavers of Hindostan. This is a striking proof of the advantage of mechanical science, and in no instance has it been exemplified so remarkably as in the preparation of cotton.

The first authentic mention of the manufacture of cotton is in an old book called the "Treasure of Traffic," published in 1641, where

the writer says, that in the town of Manchester they "buy yarn of the Irish in great quantity, and weaving it there, return the same again into Ireland to sell. Neither doth their industry end here; for they buy *cotton wool* in London, and work the same, and perfect it into stuffs." For many years the manufacture went on very slowly, and not being able to spin the cotton to a thread of sufficient strength and fineness, it was the custom to weave flax and cotton together; the long threads were of flax, the cross threads of cotton. When George III., the grandfather of our present Queen, began to reign, the value of all the cotton goods made in Great Britain was only two hundred thousand pounds sterling in the year. But within ten years a machine was invented by which a little girl, instead of using one spindle, could work from eighty to one hundred and twenty spindles at once. Afterwards the machines were much improved, and the whole process became simplified and rapid in its production of cloth. One person is now able to guide a spinning machine which spins one hundred hanks of cotton yarn in a day, containing nearly a million of yards;

how far surpassing the labours of the Hindoo women under the shady tree! So vast is the power of a spinning machine, that one of five hundred horse power, that is, equal to five thousand men constantly working, can produce five hundred miles length of cotton thread in a minute; in half an hour an extent of thread that would reach from Manchester beyond the Himalaya mountains of India. And not only in spinning and weaving do machines assist, but from the first process of cleansing the cotton wool from seeds, and remains of seed-vessels and calyx. This is called *carding*, and was formerly done by the hand, upon the knee, with a single pair of *cards;* it is now accomplished by cylindrical cards fixed in a machine and worked by machinery.

The manufacture of lace net from fine cotton thread shows in a yet more remarkable manner the superior advantage of machinery over hand work. A maker of lace on a pillow, if dexterous and diligent, could make about five meshes in a minute, and would occupy six hundred hours in making a square yard of lace net. In 1810, lace-making machines were able to make one

thousand meshes in a minute, or a square yard in two hours. In 1856, the plain lace machine was making forty thousand meshes in a minute, or a square yard in five minutes, so wonderfully had the inventions in this art of machinery improved. The rapidity of the work naturally causes cheapness of price in the article when made, for time is after all the precious thing of this world. As the production of the machines increased in quantity as well as quality, so the price gradually lowered to the buyer. In 1810, when a machine made a square yard of plain net in two hours, it cost five pounds sterling to the lady who bought it for some very choice article of dress, perhaps for a veil which she spent many laborious hours in working with such a simple pattern as she could manage, and this at a risk of injuring her eyesight. Now you may buy a square yard of net, woven in a beautiful pattern better than any worked by hand, at a less price than five shillings, and a yard of plain net might be had for fivepence.

The present enormous trade in cotton lace net is one of the wonderful proofs of the added value given by human skill and labour to a

simple material supplied by nature. The whole lace-making train of England employs upwards of one hundred and thirty-five thousand persons; the cost of the cotton in its raw state is nine hundred and eighty thousand pounds sterling, and when manufactured into net, the value rises to four millions and forty thousand pounds sterling. And this is only one example of the cotton manufacture, only that one slight article used for a few purposes, hardly to be called an indispensable part of dress materials. There are, besides, all the strong calicoes, long cloths, all the endless varieties of cotton cloths that are dyed of different colours, some of one simple hue, others of endless style of pattern. Some made to endure long wear and tear, others used only for lining other substances, and very thin. Some kinds of cloth made thick on one side with a warm down for cold climates, others of slight texture for hot countries; there is much more variety in cotton materials than in those of flax or hemp. As our power of manufacturing increased, so also did our search after increased supplies of raw cotton wool succeed, and at the present time many learned and experienced men

are endeavouring to enlarge our cotton territories; for it is now become obvious to all who look abroad on the state of the inhabitants of the world, that cotton is one of the most powerful means for good placed in the hands of man. Not only has it been a source of advantageous employment to thousands of our fellow-creatures during the last one hundred years, but it was the cause of much talent and ingenuity being developed and brought out for the benefit of those who were by situation unable to learn themselves. Moreover, many who are now raised, and most worthily to the highest ranks in our land, owe their elevation to the earnestness with which they studied the great subject of spinning and weaving cotton. How could the rapidly increased population of our country have been clothed without a simultaneous increase in the supply of cheap cotton cloths of all kinds? there is no other substance that can be obtained in such profusion.

Flax we found is fitted only for temperate climates, and is therefore limited to those regions of the world; to parts of Europe and of North America we must look for our supply chiefly.

But cotton grows over a vast district of the earth, and where land is abundant and population scanty, and so the cotton plants have space enough to develop their curious seed-vessels, and the natives find it a suitable occupation to gather the wool and get it ready for the British ships. And thus the great bales of cotton are continually coming into the port of Liverpool, and are conveyed to Manchester; and then having undergone the marvellous process of manufacture in our island of industry, it is sent forth again and dispersed all over the globe to assist in the vast work of the social improvement, civilization, and education of mankind.

We cannot fail to remark the merciful provision made in this one plant for the service of man. It is no presumption on our part to perceive in this, as in many other instances, an especial proof of the thoughtful care of the Creator for those wants which belong to humanity. There is clearly an appointed plan in the preparation of this abundant material for us, in the store of cotton wool in these seed-vessels. It is of no use to the seeds themselves; but of its value to man we cannot reckon the amount.

Its formation is especially adapted for spinning; we do not find the hairs or down of other seed-vessels so formed. The long white hairs which belong to the seeds of the Welsh cotton-grass are only fit to stuff pillows; they cannot be spun. Neither can the mass of soft down which fills the seed-vessels of the silk-cotton tree of Malabar be used for spinning; they are collected by the Hindoo women to make cushions, but for no purpose for garments. "Whoso is wise, and will observe these things, even they shall understand the lovingkindness of the Lord."

CHAPTER XII.

GENERAL REMARKS ON PLANTS.

HAVING now spent some time in examining the nature and history of plants, it will be well to look back on what we have been thinking and speaking about. As the merchant at certain periods takes account of his merchandise, of his gains and losses; as the traveller when he has reached the top of a hill stops for a while, not only to rest, but to pause and gaze over the country he has travelled through, and to note the towns, or the villages, or the forests he has passed, or the rivers he has crossed;—so likewise must the student pause from time to time, and consider what gain is acquired by the hours that have been spent in any particular study. It may hardly be thought of consequence to inquire what profit has been gained by reading these chapters; as you may suppose that this is one of those humble branches of instruction that a pupil may read or listen to or not, and not be expected either to take or to give any

account of it. A little consideration will convince you that this is not the true way of regarding any subject of instruction and education. Let us call to mind that the servant in the parable, to whom one talent was given, was expected to trade with it,—that is, to increase and profit by it,—just as much in due proportion as he who had five or ten talents entrusted to him. And in regard to the *time* we have spent on this study of plants, that is one of the most precious of all the things lent to us, one of which we must always take account strictly, in order to be able to give up our care and stewardship with joy when the appointed hour shall arrive. Time is certainly one of the things of which we ought to "gather up the fragments, that nothing be lost." The time spent in an earnest, humble, diligent endeavour to gain true knowledge and instruction is assuredly well spent, if we only take heed that what we learn is duly stored up in the mind and memory. What said the king who was "wiser than all men?"—"Wisdom is the principal thing; therefore get wisdom, and with all thy getting, get understanding." That is, not merely get wise

words and things in scattered confusion in your mind, but get all in due place and order, *understanding* the full meaning of the wise things learned. That a knowledge of plants is a thing to be desired we can feel no doubt, for a wiser king than Solomon, He who "taught as one having authority," of whom even the unbelieving and unwilling hearers exclaimed, "Whence has this man this wisdom?"—He bids us now, as he bade his disciples when they walked through the green pastures of Judea, "consider the lilies of the field, how they grow." He still warns us to "learn a parable of the fig-tree." He explains to us, in living words of truth and wisdom, that the sowing of the seed in the earth is a clear interpretation to us of the sowing the seed, the word of God, in the heart of man. The seed may be a small, hard, dry object, probably the least beautiful part of the whole plant,—far less outwardly adorned with form or colour than the leaf, or the flower, or the fruit,—generally of a dull brown hue, and scarcely to be discerned from the earth in which it is laid. But what a striking lesson does the seed of a plant teach us. Whether it be large,

as that of the lofty cocoa-nut palm; or minute, as that of the poppy, like grains of sand on the shore, yet each one is in itself perfect and complete, containing the germ of future life and growth, awaiting only the necessary circumstances to call it into existence, the right proportion of moisture, darkness, and warmth, with a sufficient supply of air. The contrast between the humble, insignificant little dark seed, and the full-grown plant in its perfect development of form and beauty of colour, filling the air around with its fragrant scent, is one of the greatest wonders to be perceived in any visible part of creation. And what a wonderful explanation it affords of those words of the apostle, "Sown in dishonour, raised in glory; sown in weakness, raised in power." Surely this rising of a glorious plant out of the small dry seed in the dark earth helps to show us that "mystery, we shall not all sleep, but we shall be changed." We lay the mean grain in the ground, to mingle with the dust, out of the sight of all men. We sow it in the early part of the year; a few weeks pass by, we look over the scene again in the brightness of the summer sun, and our eyes are

gladdened by the cheering sight. Countless strong stems are risen up, bearing green leaves of refreshing hue, and flowers of brilliant colours. What a perfect illustration of one of the most grievous perplexities of our human nature! The extreme duration of life in seeds helps also to expand our ideas concerning the limit of time and eternity; they seem to tell us that with them a thousand years are but as yesterday, and pass by like a watch of the night. Some years ago, the case of an Egyptian mummy was opened; a few grains of corn which the unenlightened heathen had placed there for the use of the dead were taken out. These were brought to England and sown in the ground after more than two thousand years of imprisonment. In the due season a plentiful crop of corn sprung up and ripened, of the true "bearded wheat" which has been constantly sown and grown in the land of Egypt since the time of the Pharaohs. The hands which had reaped that corn had long ago mouldered into dust, and the appointed time when the dry bones shall be revived and restored is not yet come; but it will come as surely as those grains of corn have sprung up

again into a new life, after their long sleep; for it was but a sleep, a state of torpor and inactivity; the seed had not withered, its life was not perished for ever. Surely if God hath so clothed the grass of the field, will he not much more clothe us.

There is still another remarkable fact which we may notice about a seed, and that is, it acquires the actual essence of vitality whilst in the seed vessel of the plant that produced it; the power of growth is not a new life given to a seed after it is in the earth; it is only a change, a development of what was already there in existence. There is one exception to the usual manner of growth of seeds which proves this fact to us. The mangrove trees, which grow on the shores of tropical countries, either on the banks of large rivers, or on the coasts of the ocean, down to the very edge of the water—form dense masses of spreading trees, intercepting the rays of the sun, and causing an extremely unhealthy climate. These are very remarkable trees; perhaps you can hardly imagine the scene without a drawing to represent it, for it is quite unlike anything in

this part of the world. But you will like to learn something about them, especially the cause of their forming so peculiar a tangled grove of interlacing branches and roots. Let us observe the growth of a young mangrove; when it is about three feet high, it begins to send forth branches on all sides, for it belongs to the class of trees with branching stems. White flowers appear, having five fringed petals; then *roots* come out of the stem, tender at first, afterwards becoming of a grey colour and firm in substance. They descend towards the ground and water, and if the points receive no injury, they penetrate the earth, and in process of time sprout upwards and become trees; thus the whole grove is most singular in appearance. The trees standing on the verge of land and water appear to be propped up by the numerous roots which come from the stem and form arches down into the water. The most curious part which I now wish you to observe, is the peculiar manner of growth of the seed. When the white flower falls away, the future seed grows beyond the green calyx, the point lengthens, and the roots pierce the covering

and descend downwards to the water, still attached to the branch above. It can resist the usual injurious effect of salt water; therefore, nothing impedes its progress, it finds the way down to the mud, there flourishes, and amidst circumstances that would be unfavourable to the growth of any other class of flowering plants, adds to the thick forest of mangroves. The air caused by these groves on the mud shores is extremely unhealthy; even the natives dare not venture to remain long in such districts. When they wish to land on the mangrove shores, they imitate the monkeys and climb dexterously among the interwoven branches, without treading on the dangerous quagmire below.

To the first Europeans who explored the islands of the Caribbean Sea, the spectacle must have been astonishing. The entangled thicket affords shelter to birds and insects innumerable; and on the sea coast oysters attach themselves to the stems and branches which are beneath the surface of the water. The course of rivers in some tropical countries is often interrupted by the encroaching man-

grove swamps, and travellers are sometimes obliged to cut a passage for their boat. On the west coast of Borneo, the landing at the mouth of some of the rivers is nearly impracticable, from the accumulation of mud amongst the roots. But all the difficulties and hindrances which Nature puts in the way of man's progress, will yield to perseverance and skilful labour; it is scarcely more than a quarter of a century since the now prosperous port and town of Adelaide, in Australia, was a mangrove swamp.* And so you have learned something about seeds, and of a curious exception to their regular plan of growth.

We cannot fail to observe how these little unattractive objects in the vegetable world become teachers to us,—how they help to enlighten "many dark sayings of old." They remind us of some things we are apt to forget; amongst others, of that warning, "As a man soweth, so will he reap." The farmer is very careful to select good, sound, seed-corn to sow in his fields; for he, at least, understands perfectly in his calling what that means, "Whatsoever a man soweth, that shall he also reap."

But let us each take care, that the children of this world are not always wiser in their generation than the children of light.

We have spoken about *roots*, and considered their nature and their twofold office to the plant to which they belong,—to absorb moisture for its use, and to hold it firm in the ground. They are also of much use to man for food in many instances, and for medicine in sickness. A few roots also, as those of the furze, are hard, and large enough to be useful in cabinet-work, for they are of a fine texture. We have several roots in this country that possess valuable properties, and before we were so well supplied with foreign articles, they were much used and esteemed, especially in country places remote from towns. Our native yellow iris, which grows abundantly in watery places in southern counties and elsewhere, has a very astringent root, that might be employed to advantage in tanning leather. In the western isles of Scotland, where the inhabitants are dependant on their own resources, the roots of the iris are used for dyeing black, and for making ink; a slice of the fresh root is also an

excellent remedy for toothache. Formerly, the roots of cowslips were added to beer to give strength and pleasant flavour; for they have a fine odour, like the flowers. Our marsh bog bean, which I described to you as an intensely bitter herb, is only valued in this country for the triple leaves, which are gathered and dried for medicinal use; but in Lapland the poor peasants are sometimes thankful to mix the pounded roots with their scanty meal, and make a kind of bread of it. We have ascertained in the chapter on roots, that they are a very important part of a plant, being the first source of a supply of that moisture which is afterwards converted into the sap and various other juices found to exist in different species of trees or herbs. It is not surprising, therefore, that the roots themselves are frequently possessed of some of those valuable properties which they are the means of obtaining. There are, indeed, instances of almost every kind of vegetable quality to be discovered in some example of a root. Perhaps you would not expect that these dry, hard, tough, underground portions of a plant, were at all likely ever to contain *oil*, and

yet the roots of the sandal-wood, that highly odoriferous tree of Malabar, do possess a portion of fragrant oil; and it is so much esteemed in the East, where, as we remarked, all perfumes are valuable, that even the chips and cuttings of the roots are collected as an article of commerce for the purpose of extracting the oil. It not unfrequently happens, that we have a native plant possessing slight properties which in another example of the same tribe are developed in greater strength. This occurs in the wild madder, a square-stalked prickly plant growing all along the west of Britain, from Cornwall to the sandy rocky isles on the west of Scotland. It has a creeping, fleshy, tender root, yielding a dull, red juice, useful for dyeing; and if we had not a plentiful supply of madder roots from another species which is very common in the south of Europe, our native plant would be much more valued and used than it is. Another example of the same kind, is that of the alkanet, growing on waste ground near the sea, in some parts of England; the long tapering root is simply mucilaginous. The dyers' alkanet of the south of France yields from its root a fine,

deep, red colour, which can be imparted to wax, oil, and all similar substances,—thus is useful in staining furniture. In chalk districts, where our wild mignonette grows, we usually find associated with it a plant having the same Latin name of reseda, but of less pleasing form, and entirely without sweet scent. It is called weld; and in the roots, as well as the whole plant, contains a dye of a bright yellow colour, very useful for wool, cotton, mohair, and silk. Blue cloths are also dipped in it to change them to green. There are yet several more useful substances obtained from roots, which you can discover and learn their history when the opportunity of so doing comes.

You will remember that there are some roots, commonly so called, which are not true roots, but only underground parts of the stem; this is proved by their containing leaf-buds, from which fresh plants grow. A potato is, strictly, not a root, but a tuber,—an enlarged part of a subterranean stem, provided with leaf-buds. Therefore, if a piece with a leaf-bud in it be put into the earth, it will produce a new plant; for there is a power of growth in these buds

as well as in seeds. Amongst the varieties of roots is one generally so called, but which is properly a bulb; as that of the hyacinth, lily, or onion. It is a body found at or beneath the surface of the ground, producing real fibrous roots from its base, and a stem upwards from its centre. The fleshy roots of the arum and the crocus differ from the bulb; they are the enlarged base of the stem, containing the reproductive portion of it. Some kinds of sedges have remarkably long roots, penetrating down into loose sand, and helping to bind together what, in many places, is very liable to be blown away by high winds. On the sandy shores of the Solway Frith, separating England from Scotland on the west, there grows in extreme abundance a short sedge, not more than a few inches high, but having long roots, serving most efficaciously to retain the light sand in its place. Many of the dykes of Holland are formed of an extremely light sandy soil, and could hardly resist the occasional force of wind and water, except they were very considerably strengthened and bound together by numerous creeping plants. What are sometimes called *creeping*

roots, are, in fact, creeping *stems*, which run horizontally under the surface of the earth, and send out true roots from joints at intervals. Of this kind is the couch grass, one of the most troublesome weeds to a farmer, for it is almost impossible to get rid of it; the more it is cut by hoe, spade, or plough, the more it multiplies, for at each joint of its creeping underground stem, springs a tuft of fresh fibrous roots below and a new stem above. There are still many curious things to be observed in roots, but we must now pass on to the stem,—that is, the central, chief support of a plant. The usual position is upright, but exceptions are found to this rule; as we have just remarked, a stem of a herbaceous plant may be creeping along, under, or above ground. When they run below the surface they are often mistaken for roots.

An example of a running stem above may be seen in the strawberry plant; the slender stems in autumn, after the fruit is over, grow to a great length,—and new plants, each furnished with roots, are produced at intervals. The stems of all our British ferns are horizontal, none grow erect; but in the Tropics, the tree-

ferns have upright stems as high as forty feet, bearing a crown of graceful foliage on the summit, with very much the appearance of palms. You can easily examine the stem of a fern growing in a wood; that of the common brake-fern is a thick mass composed of the remains of the leaf-stalks of former years; the fresh *fronds*, as the leaves of ferns are called, spring from the end of the stem, and then rise upwards. If you can take up one of these stems, you will see at once that it resembles the stem of a palm, clothed with the remains of old leaf-stalks. But the end only of this horizontal stem is necessary for the continued growth of the fern; you may break away a few inches of it and plant it again elsewhere; it will flourish perfectly well. The true roots are fibrous, and grow from the underside of the horizontal stem. Some plants are said to be *stalkless*, but all have some stalk, although it may be reduced to a very short length. The primrose is commonly called a stalkless plant, the interval between the top of the root and the flowers and leaves being so short as to be scarcely perceived. The stems of large trees possess much individual character; by which

any one acquainted with the outward appearance of trees can readily distinguish them, even in winter when there are no leaves to mark a difference. The manner of growth, the bark, the way in which the branches spring from the stem, all indicate a peculiar tree.

We have discovered the internal arrangement of a stem in the two large classes of plants, and you can believe, though you cannot see, the wonderful activity of life that is ever passing in what is generally supposed to be hard solid wood, covered with so rugged, hardened a coat of bark, that it seems to be a dead material rather than a living substance. Still we see sufficient proof in the annual growth of leaves, flowers, and fruit, that there is work going on within; and if the source of all supply of moist juices must be derived from the roots in the earth, there will of necessity be a vigorous action within the whole stem and its branches to dispense the sap. It is now ascertained that the sap of a tree flows five times stronger than blood in the horse, which is a very striking fact when we consider the difference between animal and vegetable life, how many degrees

lower in the scale of creation plants are placed than animals, especially in not having the power of motion.

There are some tribes of plants which, besides sap, have a milky juice flowing in a peculiar series of vessels, appropriated to that purpose only. One of the commonest weeds in our gardens, the spurge or milkwort, affords us a good example of the rapid flow of liquid in plants. Pull up one of these little green herbs by the root; the stem is tough, but it easily breaks asunder, and the moment you separate it, the pure white milk flows out at each end of the broken stalk with great rapidity. It is like that of almost all plants with milky juice, excessively acrid and pungent; but there is one remarkable exception in the cow-tree of Ceylon, the milk of which is wholesome and pleasant to drink. The natives make wounds in the stem, and the milky juice flows into vessels placed to receive it, and so continual is the supply, that women go early in the morning to the forests where the trees grow, to fetch it for their daily nourishment. A great variety of substances are yielded for our use by the stems of trees, besides the

first and most valuable material of wood. Turpentine, caoutchouc, gutta percha, resin, gum, benzoin, balsam, storax, are all procured from the stems of trees; all these, except turpentine from firs, are produced in hot countries, where the climate is more favourable for these kinds of secretions than in temperate regions. The common ash thrives extremely well in England, particularly in the south, but it does not exude here a peculiar sweet substance called manna, which in the south of France is obtained in abundance from cuts made in the bark; the sweetness of manna is of a peculiar nature, and not due to the presence of sugar.

There are particular properties in the sap of different trees as well as in other portions of their substance, and many of these properties are brought into great use by the inhabitants of the countries where they are found. In North America the maple yields a plentiful store of sugar from its sap, serving for many purposes as well as that of the sugar-cane. In northern countries, where grape wine is not to be obtained, a wine prepared from the sap of birch trees is much used and esteemed. The sap of palms,

we have already discovered, is of a very valuable nature, yielding wine and a spirit called arrack, to the natives of the tropics where the trees grow; in this we may remark one of the numerous instances of the universal system of compensation pervading the vegetable world in a very manifest way. Vines, producing grapes wherewith to make wine, cannot grow in hot tropical countries; neither is there any species of corn, not even maize, that is adapted to those heated, moist climates, of which malt could be obtained for beer. But it is exactly in those regions from which vines and corn are excluded that palms flourish, and afford a substitute for corn, oil, and wine—the three things most essential to the nourishment of mankind in a simple, uncivilized mode of life. All the examinations we have made of plants have been of a very humble kind, but they may have sufficed to show you how to discover hidden difficulties by slight outward signs. This is no more than we have to do in other studies; a few only amongst us have time or opportunity to devote to the researches that one subject alone would require. Let us take care that we do not perplex what

is, or may be plain to our understanding, neither expect to comprehend more than we are permitted to do. Rather let us thankfully accept such explanations as wise men may give us, and believe the effects of what we do not clearly perceive the cause.

We are told, that by the aid of powerful microscopes, scientific observers have discovered spiral vessels existing throughout different parts of a very large proportion of plants, and cells through which fluids pass. You may think it impossible for any of you to be able to examine these minute objects in the internal structure of a plant. Perhaps it is not so impossible as may be imagined. Suppose in the spring time a friend in the country sends you a few violets out of the garden in a letter. They arrive, of course, unavoidably pressed flat, for the letters are all tied up tightly in packets in the mail-bag. They still, however, retain their delightful fragrance, and have imparted it even to the paper. You wish to preserve them awhile; if you place the stalks of the flattened flowers in a cup of warm water for a few hours, they will be revived, and, often, so completely, that it seems

almost incredible that they travelled a long journey in a letter-bag. How did this revival take place? By means of the water gradually and imperceptibly rising up into the little vessels and cells, and expanding them to their original six-sided form. The stalks assume their former rounded shape, the flowers their graceful beauty; thus proving to us the truth of the assertion of naturalists, that plants are composed of cellular substance, and spiral vessels, and hollow tubes. If you wish to see also the spiral vessels, take one of the slender flower-stalks, pull it very gently asunder, the elastic spiral vessels will enable it to stretch a little; then the outer skin of the stalk breaks, and very minute, white spiral threads are clearly to be distinguished by the naked eye. Thus we perceive that in this, as in other works of creation, sufficient proof of skilful construction does exist, even for humble students, if only our eyes are open "to see the wondrous things of God's law," and if we are "not slow of heart to believe."

In the fifth chapter we spoke of leaves,—of their formation, and of their valuable service to the plant, as well as of their various uses to

man. You remember that a leaf is a hollow bag filled with fibres and pulp; and that it is closely connected with the tree or herb to which it is attached, being made out of the same fibres and cells which form the whole. Now you know thus much, you will have pleasure in noticing the various kinds of foliage that belong to different plants. You can learn a great deal about leaves in this small island-home of ours, for we have an extraordinary variety of trees in Britain. There is, probably, no other country possessing so many kinds of soil on the surface of the land in the same space; consequently, an unusual number of trees and herbs find a suitable locality. When we have once gained a knowledge of the shape and character of a leaf of any particular plant, we should know it again immediately, and could have no doubt as to the general aspect of the tree, or herb, on which it grew. And how striking it is, that all the individual characters, whether of size, quality, or property, are now just what they were "in the beginning." There is not the least reason to suppose that Nature's works have undergone the least change, except in such few

respects as the art of culture by man's skill has effected. And yet, amidst this wonderful regularity and continuance of law and rule, by which even the lowest herb appears to be governed, there is such a vast range of varied form and development, not only separating each plant from every other species, but also in each individual species, that we might find endless store of interest in tracing out the leaves merely of different plants. Every one knows the evergreen ivy, adorning old ruins, or concealing ugly walls; and any English person may know it and examine it thoroughly, for it abounds in our moist climate, though in many parts of Germany it is not to be seen. The old leaves will be always found of the same five-angled form, one we can never forget, for it has become a stereotyped pattern for all kinds of ornamental designs. But the leaves on the young flowering branches are of an oval-pointed shape, with the slightest possible indication of angles at the sides. There is no reason discoverable for this variety in the leaves of ivy.

In another instance of varied leaves on a plant, there is a probable cause to be perceived.

The water-buttercup, which abounds in some parts of England and Scotland, has a very long, weak stem, beset with leaves throughout; those which are developed beneath the water are exceedingly finely divided, whilst all the leaves that float on the surface, or rise above it, are round, and have the stalk placed in the middle of the leaf. Observations seem to prove that the union of the fibres of leaves in an extended network is effected by certain influences of the air, and prevented by the effect of water. The rapid flowing of a stream, as in the instance of the river Leven out of Loch Lomond, in Scotland, causes the leaves of this water-buttercup to be even more finely divided than in examples taken from the still water of a pond. It is quite in conformity with this law that all the plants inhabiting water solely, both fresh water and the sea, have extremely long, slender stems and finely parted leaves. Only one or two of the sea-weeds, which grow in shallow water near the shore, have wider, rounded-shaped leaves. The variety of dimensions of leaves is great, comprising every degree from the tiny leaf of a moss, to that of a palm broad enough

to thatch the habitation of a whole family of Indians.

The researches of modern travellers have made known to us two more plants having gigantic leaves. The Victoria waterlily of Guiana covers large, sheltered windings of the rivers with its majestic leaves of a circular shape, measuring three feet across, rolled up round the edge when young, covered with sharp prickles on the under surface, and thick ribs like a strong frame-work supporting it so powerfully that a child can stand on the leaf without injuring it.

Another immense leaf has been found on the sandstone cliffs of Chiloe, in South America, very rough in texture and on the surface, four or five leaves composing the whole foliage of the plant, for each one is nearly eight feet in width. The contrast between these vegetable giants and the delicate, thread-like leaf of other plants is very striking.

Amongst the eatable plants of our gardens, the fennel and the asparagus, when fully grown up, afford very good examples of leaves diminished to the mere fibrous part clothed with the

smallest possible quantity of pulpy matter. Some leaves are called *compound*, not those which have small leaflets set in pairs on a long stalk; they are *pinnated*, that is, like a comb. A compound leaf is one that has two parts jointed together. Of this the orange gives us an example; its leaf has the top of the leafstalk widened into an oval piece on each side the midrib; then a joint connects it with the true leaf, which is several inches in length. Some leaves have a peculiarity which distinguishes them readily; if you find a myrtle, not in flower, only leaves on the branches, you need have no hesitation in naming it, if you look at a leaf and perceive the unfailing sign of all myrtles, a vein running all along within the edge of the leaf from the stalk to the point. There are only a few plants of the same tribe which have this peculiar characteristic, and their leaves are not so pointed in shape. Some tribes of plants we recognise by a small addition to the leaves, a pair of narrow, pointed leaflets attached to the sides of the leafstalks at their base; they are called stipules. If you examine a rosebush, you will see what these little stipules are; they are

generally less firm in texture than the leaves, but are sometimes membranous, leathery, or spiny. The great work which leaves have to perform for the plant is to collect and receive juices, to expose them in their numerous cells to light and air, and so to assist the conversion of water into sap, and the perfecting of all the juices necessary for the development of the plant. For this duty we can suppose that the horizontal position of leaves on their stalks is especially favourable, giving the best chance to light and air for fulfilling their share of duty. In a great proportion of the trees of Australia, it is remarkable that the leaves are tough in texture, of a dull greyish hue, and set on perpendicularly, thus having the edge turned to the light. Possibly some reason may one day be discovered for this peculiarity; we know very little at present of the natural history of Australia. There is much to be observed and learned about this one portion of plants, and the whole aspect of nature depends so much upon the foliage of trees, that they cannot fail to interest us. There is no surer indication of being in a strange land or climate than the different

kind of leaves that attract our notice and give such an indescribable charm to the scene. In journeying along the Apennines, on the Italian coast of the Mediterranean, the traveller cannot fail to admire the beautiful appearance of the varied foliage clothing the sunny slopes of the mountains. The chestnut rises high with its deeply-notched, bright green, stiff leaves; then below are groves of pale grey-leaved olives, showing a great difference of hue between the dull green of the upper surface and the pale silvery tint of the lower side. Mingled with these are the large, five-lobed, dark green leaves of the fig, glossy in the sunlight, paler beneath, standing firmly on their strong stalk, each one helping the fig at its base to change the natural acid juice of the tree into the luscious sweetness of the ripe fruit. Then on the very shore of the calm Mediterranean grow the thick, fleshy-leaved aloes, their edges having a sharp spine at the end of each notch; plants belonging to the south naturally, only occasionally seen in gardens in our northern latitude. And then what endless beauty do leaves give to the scene by their colour only, throughout the whole

course of the seasons, from spring to the very close of autumn. First the pale silvery buds glistening on the boughs in the early sunny days of the year, forcibly reminding us that, although we do "all fade as a leaf," yet that all things, and we also, shall be made new, in the appointed time. There seems to be no end to the interesting observations to be made on the leaves of plants; a collection of them alone would be very instructive, and, to those who study drawing, there are no better objects to be used as models; every line of their form is graceful, and combines symmetry, firmness, and delicacy more than in any other part of plants. Flowers display more brilliant beauty, and their varied size is quite as remarkable as that of leaves. Some are so minute, that their complicated structure can scarcely be discerned without the aid of a magnifying glass. Others, as that of the brugmansia of Brazil, is a foot in length, extremely elegant, drooping its snow-white bell, parted into five points, on the stalk. One of the largest flowers known is the last discovered waterlily of South America, the Victoria; the flowers have only four points to the calyx, but

as many as a hundred petals, pink and white. The fully expanded flower measures fifteen inches across, and is a noble specimen of the tribe, of which all possess considerable beauty.

Concerning the changes of colour which the petals of flowers pass through, there are many remarkable facts to be observed, though not accounted for. The climbing cobœa of Mexico, which appears to be now almost accustomed to our climate, showing an extraordinary capacity for extending its growth in a slightly heated conservatory, is an example of change of colour. The flower is of a rounded bell shape, parted into five points at the top; in the bud the whole is as green as the calyx, but, as it begins to expand, the green hue gradually passes away, and the upper part of the bell becomes purple. This occurs with unfailing regularity in every blossom that unfolds itself. Some flowers acquire their full tint in the bud, as the rose; then others change as they begin to fade; the sweet-scented gardenia of the East Indies is a pure white at first, and gradually, as it begins to fade, becomes a pale clear buff, not the usual hue of

a withered flower. The bright little Virginian stock, which forms one of the gayest border flowers of spring, and flourishes even in towns, becomes a much more blue purple in fading than it is at first. The exquisite flowers of the climbing convolvulus are of various colours in the same group—that is, pure white, streaked, pink, blue, and every shade of purple; but as the vigour of the plants abates, towards the end of summer, the blue flowers diminish, and the last are not only of smaller size, but generally pale pink or white. There is much to be studied in all these observations; for we know as yet but little of the cause, though the effects are visible.

Then, as to the property of fragrance in flowers, how very slight is the knowledge of what rules that part of their composition; more especially remarkable does it seem to us when the sweet scent is not permanent, but is only perceptible towards sunset. The night-scented stock, which we have from the south of Europe, is a very small plant, slender stem and leaves, the whole scarcely a foot high. The dull purplish cross-petaled flowers attract no attention during the

daytime, but at sunset their delightful fragrance is sure to be noticed; before morning dawns, it has passed away again.

Another very mysterious fact in the history of flowers is, that although as a rule it is supposed that the light of the sun is essential to their perfect development, yet there are a few exceptions, —some examples of plants which appear to be only able to unfold their treasures during the dim twilight of a summer evening. Several of the South American cactus tribe afford an example of this peculiarity. Although many are of a brilliant crimson, and are developed only in the full light of day, which is particularly necessary to the perfecting of a deep bright red colour, yet there are several species either entirely white, or having some very pale yellow petals in the centre, which are "night-blowing," beginning to open the long buds at sunset, and displaying their exquisite glittering stars for the short space of time until the light of day again rises over the earth. It is quite in accordance with what is already known of the laws of light and colour, that these evening-blowing flowers should be white, or of a very pale colour, never *red*,—that

is evidently only to be fully developed under a strong sun-light; all the deep crimson or scarlet flowers came to us from hotter climates than our own. The only two red flowers we possess in our very numerous British Flora, are the poppy and the shepherd's clock, and both these grow in open sunny corn-fields, never in the shade of woods or hedges. There is one proof to be observed, in regard to the necessary influence of a bright sun in producing red, which is, that colour-makers never attempt to prepare carmine, the purest crimson known, except in sunlight; and, in general, it is prepared on the continent where the air is purer and the light clearer than in our moist island atmosphere. Our celebrated Turkey red cotton handkerchiefs used to be sent to Germany to be dyed, because of the superior brightness of colour acquired there. Then how wonderful is the texture of the petals, when we examine it, not merely glance at a flower and admire its beauty of form or colour; here again we find nature and art in unison. Take the petal of a pink rose, hold it by the thick firm claw, by which it is attached at the base, rend it gently

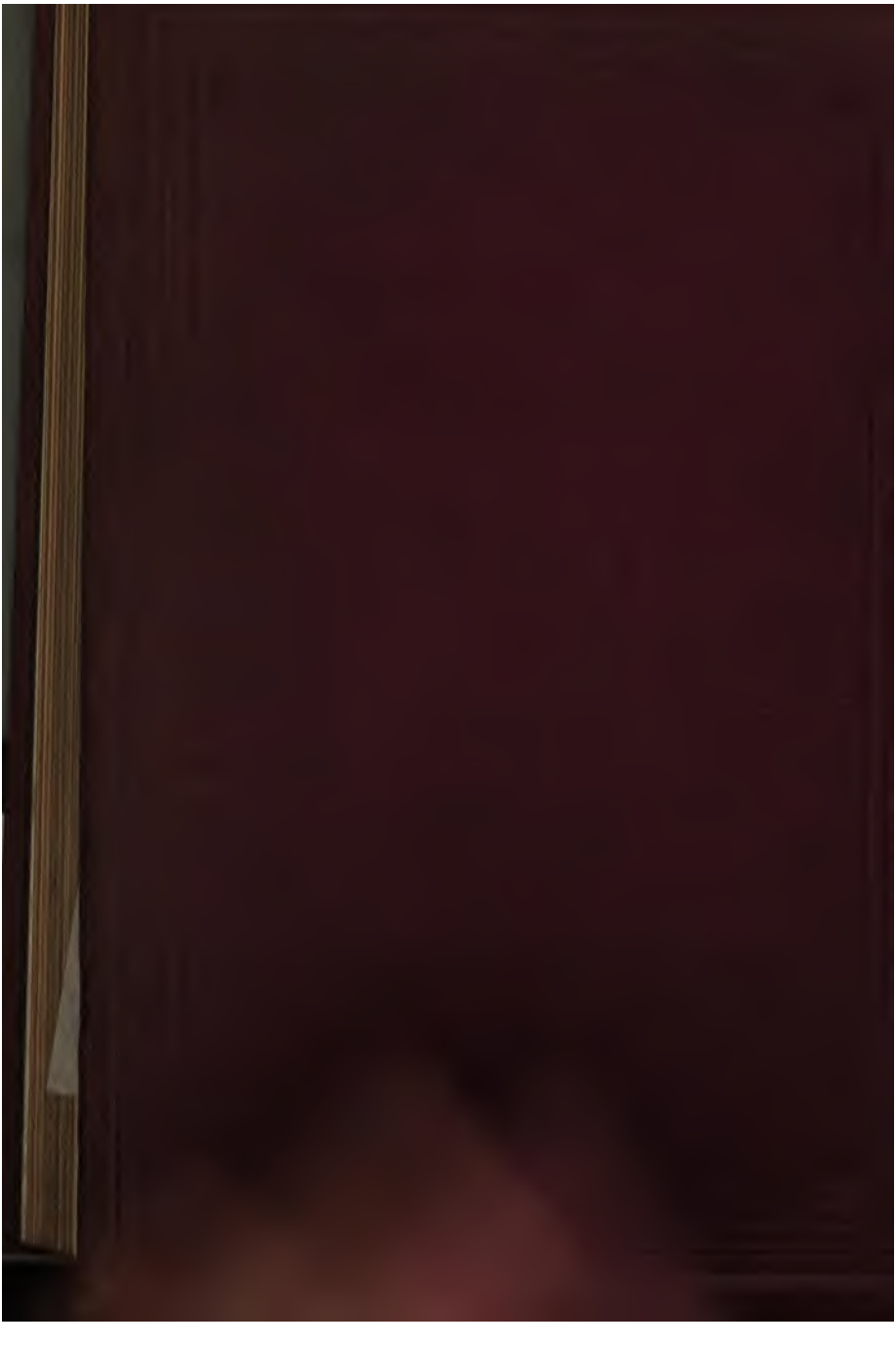
to raise the upper surface, you will perceive that the thin, delicate upper membrane is pink, but beneath the petal is of a pure white; lift up the under surface carefully from the end, and you will see clearly that the petal of the rose, which seems only to be one single piece, is actually composed of three layers; and, moreover, so arranged as to give the best effect to its lovely hue. When a painter desires to give any object of his picture a particularly pure transparency, he lays on white first, underneath the bright tint. The material of which the petals of a flower are formed is of a very fine nature, well calculated to reflect and to transmit light. See how the petals of the common buttercup shine like pure gold in the sun; those of many flowers absolutely sparkle as if powdered with fine gold, and the tall white lily glitters like silver when the sun shines on it. I have been surprised at the striking change in the colour of an orchideous flower, which looked of a dark brown till the sun suddenly gleamed through its strangely formed upper petal and it became crimson. Not only do plants, and above all

their flowers, afford us endless topics of pleasant study and recreation in their wonderful structure, but there are many other subjects of interest connected with them and their history.

If we were to carry on these studies on plants further, there is very much to remark about their distribution over the face of the earth. This is a wide subject, and full of interest. Here, as in other parts of the natural history of plants, there are clear laws and rules pervading all things, the reason of some of which we can see, but others are hidden from the eyes of our mind. The peculiar soil or situation that is indispensable to some few plants is worthy of note, whilst others can spring up anywhere. Some had been waiting for centuries to swell their hard seeds and rise up above ground to join the "green things upon the earth," till in these last days a new railroad was to be formed, and, as it could not be carried over a hill like the old roads, a deep cutting in some places had to be cleft through a chalk hill. The next spring the banks were observed to be

sprinkled with wild English mignonette and other plants of a different kind from those which had been seen before on the surface, where the soil was of a different nature. On a bank lately cut at the new railway station at Wandsworth, in Surrey, the rare plant *Isatis tinctoria*, the wood of the ancient Britons, has sprung forth again into existence, from seeds long buried at too great a depth to germinate. So also in digging wells, earth has been brought up from a depth of two or three hundred feet, carefully covered over to prevent any seeds from being dropped into it, and presently plants sprung up, undoubtedly from seeds already in the depths of the earth. Some trees and herbs seem to await their time until a certain proportion of alkaline, ashy matter, is in the soil. After pine forests have been burned down in North America, other kinds of trees, such as oak and maple, spring forth into existence. After the great fire of London, nearly two hundred years ago, a particular kind of wild mustard plant was observed for the first time, and has continued on old walls ever since. When the French

invaded Russia in 1812, the city of Moscow was burned to ruins; afterwards a Hungarian plant, not known there before, grew up amidst the ashes.

But we must now conclude these considerations on plants, not because the subject is exhausted, for it is one to which the words of Solomon may truly be applied, "Of making many books there is no end." Plants both in their native and cultivated state are objects of our constant interest. A garden was the first peaceful abode of mankind on earth; and it was the first happy occupation of man "to dress it and to keep it." Even now, in this late period of the world, when it is approaching towards six thousand years of its existence, a garden of plants forms one of the earliest pleasures of childhood, as well as one of the most agreeable resorts of old age. But whether our lot be in a garden, or in the woods, or in the fields, or possibly in the crowded homes of cities, still plants do in all places minister to our daily comfort, as well as contribute largely to the innocent recreation and enjoyment of life. I hope you will

pursue the study, feeling assured that it will lead you onwards to, at least, one of Wisdom's many paths of pleasantness and peace; and that here you may find one answer to the question of the patriarch of Uz, "Where shall wisdom be found, and where is the place of understanding?"